

UNITED STATES OF AMERICA:
WAR DEPARTMENT.

MONTHLY WEATHER REVIEW.

(GENERAL WEATHER SERVICE OF THE UNITED STATES.)

OCTOBER, 1887.

CONTENTS.

| | Page. | | Page. |
|--|-------|--|-------|
| INTRODUCTION..... | 265 | INLAND NAVIGATION.—Stage of water in rivers and harbors ; Ice ; High tides..... | 285 |
| ATMOSPHERIC PRESSURE.—General distribution ; Comparison of barometric means with those of previous month ; Departures from normal ; Barometric ranges ; Areas of high pressure ; Areas of low pressure..... | 265 | ATMOSPHERIC ELECTRICITY.—Auroras ; Thunder-storms..... | 286 |
| NORTH ATLANTIC STORMS.—Movements of high barometer areas over the north Atlantic Ocean ; North Atlantic storms for October, 1887 ; Ocean ice ; Fog | 273 | MISCELLANEOUS PHENOMENA.—Forest and prairie fires ; Meteors ; Migration of birds ; Mirage ; Sand storms ; Sun spots.. | 286 |
| TEMPERATURE OF THE AIR.—General remarks ; Ranges ; Deviations from the normal ; Low temperatures ; Frosts ; Ice ; Temperature of water..... | 278 | VERIFICATIONS.—Indications ; Cautionary signals, October ; Cold wave signals ; Cautionary signals, September ; Local verifica- tions ; Errata..... | 287 |
| PRECIPITATION.—General distribution ; Deviations from the av- erage ; Excessive monthly precipitation for October ; Drought ; Sleet ; Snow ; Hail..... | 280 | STATE WEATHER SERVICES.—Extracts from reports of the several services | 289 |
| WINDS.—Most frequent directions ; High velocities ; Local storms ; Water-spouts | 284 | NOTES AND EXTRACTS.—Direction of movement of areas of low pressure ; Temperature and precipitation tables ; Atlantic weather charts ; Meteorological tables..... | 291 |
| COTTON-REGION REPORTS.—Comparison of mean temperatures and rainfall with normals..... | 285 | METEOROLOGICAL TABLES.—Data from stations of the Signal Service ; Data from stations of voluntary observers..... | 294 |
| | | CHARTS.—I. Tracks of areas of low pressure ; II. Isobars, isotherms, and winds ; III. Departures from normal atmospheric pressure and temperature ; IV. Precipitation. | |

PREPARED UNDER THE DIRECTION OF
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List of merchant marine steam and sailing vessels from which International Simultaneous Meteorological reports were received at the Office of the Chief Signal Officer, U. S. Army, Washington, D. C., in time to be used in the preparation of the Weather Review for the month of October, 1887.

| Name of vessel. | Captain. | Name of vessel. | Captain. | Name of vessel. | Captain. |
|--|------------------------|---|--------------------|---|-----------------------|
| Allen Line. | | Legland Line. | | Warren Line. | |
| Br. s. s. Buenos Ayres | Capt. J. Scott. | Br. s. s. Bulgarian | Capt. E. Parry. | Br. s. s. Kansas | Capt. W. Gleig. |
| Grecian | C. E. Le Gallias. | Virginian | M. Fitt. | Norseman | D. Morris. |
| Mexican | Wm. Donlap. | Mallory Line. | | White Cross Line. | |
| Sarmatian | W. Richardson. | Am. s. s. Alamo | Samuel Risk. | Belg. s. s. DeBaylor | J. J. Brarens. |
| Scandinavian | John Park. | Carondelet | W. F. Evans. | Jan Breydel | H. Meyer. |
| American Line. | | Colorado | J. Daniel. | Pieter de Coninck | E. Smit. |
| Br. s. s. British King | John Kelly. | Lampasas | M. B. Crowell. | White Star Line. | |
| British Princess | E. H. French. | Nasco | J. Bolger. | Br. s. s. Adriatic | I. G. Cameron. |
| Indiana | W. J. Boggs. | State of Texas | Gilbert Williams. | Arabic | Geo. Barton. |
| Lord Gough | E. M. Hughes. | Mediterranean and New York S. S. Co. | | Britannic | H. Farsell. |
| Anchor Line. | | Br. s. s. Ponca | W. Bowen. | Celtic | P. J. Irving. |
| Br. s. s. Alexandria | D. Fort. | Pontiac | H. W. Brown. | Germanic | Benj. Glendell. |
| Albatross | J. Brown. | Ministoga & Dominion Steamship Co. | | Wilson Line. | |
| Anchorage | W. Brown. | Br. s. s. Vancouver | C. J. Lindall. | Br. s. s. Bassano | W. Bas. |
| Calcedonia | F. Hassenstein. | Morgan Line. | | Buffalo | J. H. Malet. |
| Circadia | A. Campbell. | Am. s. s. Enreka | H. B. Quick. | Egyptian Monarch | John Harrison. |
| City of Rome | H. Young. | National Line. | | Galileo | R. T. Jones. |
| Desunio | W. G. Crockett. | Br. s. s. Canada | J. Robinson. | Otranto | W. Rippeth. |
| Dorian | J. McKague. | Denmark | R. S. Rigby. | Salerno | B. H. Rogers. |
| Ethiopia | John Wilson. | England | J. Sumner. | Sorrento | F. W. Ouston. |
| Furumia | J. Hedderwick. | Egypt | A. F. Healey. | Miscellaneous. | |
| India | John Jameson. | Erin | Thos. Foot. | Br. s. s. Aguan | John Adair. |
| Olympia | L. Swain. | France | A. D. Hadley. | Belair | Geo. Dunlop. |
| Sidonian | E. Jamison. | Greece | A. J. Jeffrey. | Ben Ledl | S. Adamson. |
| Trinacria | G. Mitchell. | Helvetia | G. Cochran. | Chilian | E. F. Bannister. |
| Tyrian | Alex. Haig. | Holland | Wm. Tyson. | Earnmoor | R. J. Grey. |
| Atlas Line. | | Italy | Wm. Pearce. | Edith Godden | J. H. Bennett. |
| Br. s. s. Alona | E. J. Seiders. | Spain | W. A. Griffiths. | El Callao | Joseph Schlotz. |
| Alvina | F. McKay. | The Queen | T. P. Healy. | Elcano | Vin. de Iapizna. |
| Alvo | D. Williams. | New York and Cuba Mail S. S. Co. | | Elpis | Frank Burnett. |
| Athos | H. Low. | Am. s. s. Clenfuogon | F. M. Faircloth. | Emiliano | Don F. Bengon. |
| Charibel | J. Evans. | N. Y. Havana & Mexico Mail S. S. Co. | | Gallego | L. de Arrizalaga. |
| Booth's S. S. Co. (limited). | | Am. s. s. City of Alexandria | J. W. Reynolds. | Hugo | A. de Mugica. |
| Br. s. s. Augustine | Ralph Harwood. | City of Washington | W. M. Rittig. | India | M. Hulsen. |
| Bordeaux Steam Navigation Co. | | North German Lloyd Steamship Co. | | Kings Cross | G. J. Mills. |
| Fr. s. s. Chateau Lafite | C. Olivier. | Ger. s. s. Aller | H. Christoffen. | Liscard | T. Byrne. |
| Chateau Leoville | M. Le Chaplain. | America | H. Hineke. | Lorenzo D. Baker | W. F. Wiley. |
| Chateau Yquem | C. F. Journell. | Donau | M. Moller. | Manuel L. Villaverde | A. Gardon. |
| British City Line. | | Eider | P. H. Berdrow. | Merchant Prince | Chas. Taylor. |
| Br. s. s. Brooklyn City | W. Fitt. | Elbe | G. Meyer. | Navarro | S. de Aldecoeca. |
| Minola | Thos. L. Evans. | Ems | Th. Jungst. | Ocean Prince | W. J. Milburn. |
| Canada Shipping Company. | | Fulda | R. Ring. | Pacific | G. Evans. |
| Br. s. s. Lake Winnipeg | L. M. Framnor. | Main | H. Boedicker. | Pomona | J. Legoe. |
| Cornwall Line. | | Saale | H. Richter. | Pydian | Moses Parry. |
| Am. s. s. Hudson | H. B. Freeman. | Trave | W. Willigerod. | Boxbury Castle | A. Turpin. |
| Louisiana | E. V. Gager. | Werra | R. Bussine. | Saint Bonans | Henry Campbell. |
| Clyde Line. | | Woner | H. Bruns. | Serra | F. de Luzaraga. |
| Am. s. s. Yosemite | 1st Off. J. C. Norton. | Ocean Steamship Company. | | Surrey | R. Griffiths. |
| Chesed Line. | | Am. s. s. City of Augusta | J. W. Catherine. | Thornhill | James Wetherell. |
| Br. s. s. Auraria | Capt. W. H. P. Hains. | Occidental and Oriental S. S. Co. | | Vertumnus | C. E. Cook. |
| Bethania | T. Dutton. | Br. s. s. Oceanic | John Metcalf. | Viola | L. Murray. |
| Cephalonia | Henry Walker. | Am. s. s. Manhattan | Frank Stevens. | Winston | J. B. Millard. |
| Etruria | T. Cook. | Pacific Mail Steamship Company. | | Wylo | T. L. Rogers. |
| Pavonia | A. McKay. | Am. s. s. Acapulco | J. M. Caverly. | New York Herald Weather Service. | |
| Scythia | T. Roberts. | City of New York | E. B. Seale. | Br. s. s. Atlas | J. W. Sansom. |
| Servia | H. McKay. | City of Paris | L. Dexter. | Algiers | J. B. Percy. |
| Umbria | W. McMicken. | Newport | W. G. Shackford. | Atlas | J. W. Tobin. |
| Valer Line. | | Quebec Steamship Company. | | Barracosta | Robert Hubbard. |
| Fr. s. s. Neustria | P. Verrie. | Br. s. s. Muriel | G. S. Locke. | Caracas | N. M. Hopkins. |
| Farne Line. | | Orinoco | James S. Garvin. | City of Puebla | John Deaken. |
| Br. s. s. British Crown | A. Smith. | Red "D" Line. | | El Monte | J. W. Hawthorn. |
| British Queen | B. Willis. | Am. s. s. Philadelphia | Sam. Hess. | El Paso | H. S. Quick. |
| General Trans-Atlantic Steamship Co. | | Valencia | Wm. Woodrick. | Knickerbocker | F. Kemble. |
| Fr. s. s. La Bourgogne | E. Frauguel. | Red Star Line. | | Lepanto | Thos. M. Irvin. |
| La Bretagne | M. de Jouselin. | Belg. s. s. Belgenland | W. A. Beynon. | Landaff City | T. H. Gore. |
| La Champagne | E. Traub. | Nederland | A. J. Griffin. | Martello | Wm. Abbott. |
| La Gascogne | C. Santelli. | Noordland | H. E. Nickels. | Nova Scotia | R. H. Hughes. |
| La Normandie | G. de Kersabiec. | Pennland | Rud Weyer. | Portia | Henry Dawson. |
| Great Western S. S. Line. | | Rhinland | J. C. Jamieson. | W. A. Scholten | G. Bakker. |
| Br. s. s. Dorset | Ch. Off. E. Crossman. | Switzerland | J. Ueberweg. | Sailing vessels. | |
| Warwick | Capt. L. Morice. | Vaderland | C. H. Grant. | Am. bg. Abbie Clifford | D. W. Storer. |
| Worcester | W. Stamper. | Weserland | H. Buschmann. | Br. bk. Abyssinian | John Hughes. |
| Union Line. | | Westernland | Com. W. G. Handle. | Br. bk. Achash | Alfred M. Shaw. |
| Br. s. s. Alaska | Geo. S. Murray. | Rotterdam Line. | | Am. bk. Alice | W. G. Kair. |
| Arima | S. Brooks. | Dutch s. s. Edam | Capt. J. H. Taat. | Swed. bk. Arab Steed | C. A. Skantz. |
| Nevada | J. Douglas. | P. Caland | F. H. Bonjer. | Ger. bk. Atlanta | A. Witte. |
| Wisconsin | E. Bentley. | Loerdam | G. Stenger. | Am. sp. Big Bonanza | C. J. Andrews. |
| Wyoming | C. L. Rigby. | Schiedam | A. Potjer. | Ger. bk. Bremerhaven | Bothe. |
| Hamburg-American Line. | | Rotterdam | G. J. Vis. | Ger. sp. Carl | T. Hashbagen. |
| Ger. s. s. Bohemia | H. Kariowa. | Royal Mail Steamship Co. | | Br. sp. Chas. S. Whitney | Geo. D. Spicer. |
| Gellert | W. Kuhlwein. | Am. s. s. City of Dallas | C. W. Read. | Ger. bk. Cornelius | H. Windhorst. |
| Gothia | H. Bauer. | State Line. | | Ger. sp. Dakota | N. E. Schaffer. |
| Hammonia | C. Heblch. | State of Georgia | G. Moodie. | Nor. bk. Grundloven | O. G. Ellingsen. |
| Leoning | H. Barande. | State of Indiana | A. Ritchie. | Am. bk. Henry Warner | S. Falch Muns. |
| Maestia | H. Vogelbaum. | State of Nebraska | A. G. Brans. | Ger. sp. Ida | John Winters. |
| Regia | C. Kordell. | State of Nevada | J. A. Stewart. | Br. bk. Jose E. More | A. Lenhard. |
| Sylvania | H. Schmidt. | Thingvalla Line. | | lkt. Josephine | Chas. Brown. |
| Suecia | C. Ludwig. | Dan. s. s. Geleer | C. W. Muller. | Nor. sp. Komandor Svend Foyen | John Bryde. |
| Wimland | A. Alberts. | Hekla | A. G. Thomsen. | It. bk. Lazzaro Bianchia | Dallorso Nicola. |
| Yuma Line. | | Island | S. Skjoldt. | Am. bg. L. F. Munson | J. V. McKowen. |
| Br. s. s. City of Chester | A. Lewis. | Thingvalla | S. T. H. Laub. | Lillian | H. T. Schive. |
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| Ohio | R. W. Sargent. | Ger. s. s. Australia | G. Franch. | Br. bk. Mary | Chas. Acoks. |
| Pennsylvania | A. D. Thomas. | California | O. Winkler. | Am. bk. Matthew Baird | J. P. Williams. |
| Tokushima Line. | | Marzala | N. Maas. | Ger. bk. Pillau | G. Gerlach. |
| Br. s. s. Baltimore | J. Tremery. | Polaria | Johannes Schade. | Nor. bk. Oveo | G. Olsen. |
| Lamport & Holt's Steamship Company. | | Polynesia | A. Kuhn. | Ger. bk. Richard | A. von Seggern. |
| Br. s. s. Daniel | C. J. Watson. | Taormina | G. W. Koch. | Br. bk. Rothienay | Ch. Off. O. M. Lund. |
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| Belg. s. s. Kepler | Capt. P. H. Tanner. | | | | |

UNITED STATES SIGNAL SERVICE

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INTRODUCTION.

This REVIEW treats generally the meteorological conditions of the United States and Canada for October, 1887, and is based upon reports of regular and voluntary observers of both countries. Descriptions of the storms which appeared over the north Atlantic Ocean during the month are also given, and their approximate paths shown on chart i, on which also appears the distribution of icebergs reported, and the limits of fog-belts to the westward of the fortieth meridian. In tracing the centres of the paths of these storms, data from the reports of two hundred and fifty-one vessels have been used. The most important storm of the month passed eastward from Newfoundland during the 23d, and advanced over the ocean, north of the trans-Atlantic tracks, to the British Isles by the 29th.

When compared with the average for corresponding months of previous years there was a deficiency in the aggregate quantity of ocean ice reported for October, 1887. There was, also, a marked diminution in the number of fog-banks reported, when compared with reports received for September and the summer months.

The mean temperature of the month is decidedly below the normal in nearly all parts of the country east of the Rocky Mountains, the deficiencies being greatest in the Lake region, where they range from 4° to 8° . In the middle and south Pacific coast regions the month was much warmer than usual for October. In northern California the mean temperature ranges from 4° to 10° above the normal.

The precipitation was excessive in the south Atlantic and east Gulf states; also over several comparatively small areas to the west of the Mississippi, but over the greater part of the country it was deficient, the rainfall in the central valleys being decidedly below the average.

Under the heading "Drought" will be found a table showing the average precipitation in the various districts for the first ten months of the year, with the normals for the corresponding period of former years. It will be seen that thus far the rainfall of 1887 is below the normal in a majority of the districts of the country.

In the preparation of this REVIEW the following data, received up to November 20, 1887, have been used, viz., the regular tri-daily weather-charts, containing data of simultaneous observations taken at 133 Signal Service stations and 22 Canadian stations, as telegraphed to this office; 174 monthly journals and 176 monthly means from the former and 22 monthly means from the latter; 268 monthly registers from voluntary observers; 59 monthly registers from United States Army post surgeons; marine records; international simultaneous observations; marine reports through the co-operation of the "New York Herald Weather Service;" monthly weather reports from the local weather services of Alabama, Illinois, Indiana, Kansas, Michigan, Minnesota, Missouri, New England, New Jersey, Ohio, Oregon, Pennsylvania, South Carolina, and Tennessee, and the Central Pacific Railway Company; trustworthy newspaper extracts, and special reports.

ATMOSPHERIC PRESSURE (expressed in inches and hundredths).

The distribution of mean pressure for October, 1887, determined from the tri-daily telegraphic observations of the Signal Service, is shown by isobarometric lines on chart ii.

The mean pressure for the month is greatest in the northern plateau and north Pacific coast regions, the area of barometric maxima being inclosed by the isobar of 30.15. Within this area a number of stations report mean pressures of 30.18—the maximum for the month. Over the Gulf of Saint Lawrence, southern Florida, and southwestern Arizona, the pressure is slightly below 29.9—the lowest monthly mean reported being 29.84, at Yuma, Ariz. The monthly barometric means range between 30.0 and 30.1 over nearly the whole country, the exceptions being a narrow area extending from Lake Superior eastward to the Atlantic coast, along the southwestern border from western Texas to the Pacific, and in Florida and along the east Gulf coast. The difference between the highest and lowest monthly means reported is .34, which is about the same as the range for the preceding month.

The mean pressure, as compared with that for the preceding month, shows an increase in all districts west of the Mississippi; an increase also occurs in Illinois and Indiana and thence southward to the Gulf coast. The excess over much the greater part of the region mentioned ranges from .05 to .19, the maximum departures occurring in the northern and middle plateau districts. Along the Atlantic coast, and in the Lake region

and Saint Lawrence Valley, the mean pressure is below that for the preceding month, the deficiencies generally ranging from .04 to .08 along the Atlantic coast, and from .08 to .14 in the Lake region.

The departures from the normal October pressure for the various stations are given in the tables of miscellaneous meteorological data; they are also graphically exhibited on chart iii by lines connecting stations of normal or equal abnormal values. From the latter it is shown that the deficiencies occur in southern Arizona and California, and in all districts east of the Mississippi River. The deficiencies in Arizona and California are very slight, not exceeding .04, but in some districts east of the Mississippi they are quite marked, New England and the Canadian Maritime Provinces showing maximum deficiencies ranging from .10 to .13. To the westward of the Mississippi the mean pressure is everywhere above the normal, except in California and southern Arizona, the excess ranging from .10 to .15 in the northern plateau and north Pacific coast regions.

BAROMETRIC RANGES.

The monthly barometric ranges at the various Signal Service stations are also given in the tables of miscellaneous meteorological data. To the eastward of the one hundredth meridian the ranges for this month conform, as usual, to the general rule, that is, they increase with the latitude and decrease

slightly, though somewhat irregularly, with increasing longitude until reaching the meridian named. Over the eastern Rocky Mountain districts the ranges first increase with the latitude to the fortieth parallel, and thence decrease with increasing latitude to the northern boundary of the United States. In the states bordering on the Atlantic coast the extreme ranges are .34 at Cedar Keys, Fla., and 1.32 at Eastport, Me.; over the interior of the country, .55 at Shreveport, La., and 1.41 at Saint Vincent, Minn.; on the Pacific coast, .43 at San Francisco, and .86 at Port Angeles, Wash.

In the Rocky Mountain region and extreme northwest the ranges exceed the normal October range by from .3 to .5; elsewhere no marked departures occur.

AREAS OF HIGH PRESSURE.

Six comparatively well-defined areas of high pressure have appeared within or near the field of observation in the United States and the adjacent Canadian frontier during the month. Three of these areas apparently entered Washington Territory from the north Pacific, crossed the country, and passed into the Atlantic from the coasts of North Carolina and the middle Atlantic states.

Two moved southeastward from the western Saskatchewan Valley into the United States, one of which, progressing in the same general direction, reached the Atlantic on the coast of New Jersey, the other, trending northeastward in Nebraska, passed into the Gulf of Saint Lawrence from the northern coast of New Brunswick.

The sixth high area moved from the British Possessions northeast of Manitoba in a generally southwesterly direction toward Texas and New Mexico, and at the close of the month traces of it were still apparent in that vicinity and to the northwestward.

The mean direction of translation was southeast, and all marked trends occurred between the ninetieth and one hundred and second meridians.

The maximum high area of the month was that described as number v, and the cool wave which accompanied it was felt generally throughout the United States.

Two areas of relatively high pressure appeared within the limits of observation on the coasts of the United States and Canada on the morning of October 1st, one central to the southeast of Nova Scotia, extending inland over the Maritime Provinces and adjoining regions, the other off the north Pacific coast, near the shores of Oregon and Washington Territory. The passage of the former across the country in September has been described in the REVIEW for that month (see high area number vii) and its subsequent probable progress noted. It apparently continued its movement to the northeast and passed farther seaward beyond the limits of observation on the night of the 1st, without specially influencing weather conditions on the adjoining coast.

I.—The high area referred to as on the north Pacific coast advanced inland during the night of the 1st, and on the morning of the 2d was central in northeastern Oregon. Moving southeastward, with but little energy, over the Rocky Mountains and northern slope it passed into Nebraska and was central near North Platte on the morning of the 3d. The pressure was then above the normal from the Missouri River westward over the northern and middle slopes and plateaus to the eastern borders of California, Oregon, and Washington Territory, and from about the thirty-fifth parallel northward to British America; elsewhere it was below the normal. The maximum pressure, which mainly covered Wyoming, Nebraska, and Kansas, averaged less than .1 above the normal, but as an area of low pressure, about .8 below the mean, then existed in the vicinity of Mackinaw City, Mich., the gradients were quite marked, and violent gales prevailed on the Lakes. During the succeeding night the area was slightly re-enforced by higher pressure which apparently descended from the vicinity of Manitoba. Afterwards it moved southeastward, and on the night of the 4th was accompanied in its progress by a cold

wave which caused killing local frosts in Wisconsin and eastern Minnesota. It continued to advance in the same general direction, and reached the coasts of the Carolinas on the afternoon of the 6th, where it remained approximately stationary, with slight oscillations in pressure, up to the night of the 8th, when the barometer fell to the normal under the influence of a low area over the Lakes.

II.—During the night of the 6th the pressure over Washington Territory and Oregon was considerably increased, apparently by the approach of a higher area from the north Pacific. The temperature throughout the northern plateau region fell slightly below the normal, and light local frosts occurred in southern Idaho. On the morning of the 7th a decided depression existed over the eastern slope of the Rocky Mountains and the Missouri Valley, influencing weather conditions from the upper lake region, Ohio Valley and Tennessee, and eastern Gulf states westward to the Pacific. The area of comparative high pressure, about .6 above the minimum at the centre of the disturbance, was comprised in the region to the north and west of a line drawn diagonally from the Red River on the British border to the fortieth parallel on the coast of California. A portion of this high area crossed the Rocky Mountains on the night of the 7th and on the morning of the 8th covered the northern slope, but the main area remained on the north Pacific coast. The temperature over Montana fell from 2° to 8° below the normal, and killing local frosts were reported in that territory on the night of the 7th. The detached area moved southeastward into the Missouri Valley, attended by killing frosts in southern Dakota on the night of the 8th; afterwards it remained approximately stationary in that region until it became merged in the higher area advancing from the Pacific.

The main area began to move southeastward from the coasts of Washington Territory and British Columbia on the afternoon of the 9th. Light local rains fell on the mountain slopes during its passage, and light snow in portions of Montana. The advance wave of this high area progressed rapidly, and by the morning of the 10th covered the entire country from the Mississippi, Ohio Valley, and upper lakes westward to the Pacific, except portions of the west Gulf states and the territory bordering Mexico and California. The maximum pressure, about .6 above the normal, which had apparently been receiving successive re-enforcements from the Pacific near northern Washington Territory and British Columbia, still remained central west of the mountains in northern Idaho, near the British border. Local rains were numerous on the eastern slopes of the mountains and in the central valleys, and continued throughout the Lake region and portions of New England, where they had accompanied the progress of the depression above referred to. The maximum pressure subsequently crossed the mountains and on the morning of the 11th, with no marked change in energy, was central over eastern Wyoming and adjacent portions of Dakota and Nebraska, while the advanced waves had moved farther to the eastward and southward. The attendant cool wave, whose temperature ranged in a few instances as low as 13° below the normal, caused many local frosts in the Missouri Valley and adjacent slopes. Rains had generally ceased, but still continued in the Rio Grande Valley, where 5.54 inches had fallen at Brownsville, Tex., during the preceding twenty-four hours, and in portions of New England and the Maritime Provinces. High winds, generally from the northeast, had also prevailed on the coasts of Texas for about sixteen hours and had not yet materially abated. During the next sixteen hours the centre of the high area moved, with diminished energy, into northwestern Texas and Indian Territory, where it assumed the form of a narrow trough, open towards the Mexican frontier and reaching northeastward to the Arkansas River. Gales from the north and east still continued on the Gulf coast from the mouth of the Mississippi westward, and had also set in on the Lakes from the northwest. During the night of the 11th the area remained approximately stationary, but the pressure near the centre decreased about .2, and the attendant cold wave, which

extended northeastward from Louisiana, Texas, and Indian Territory to the borders of the Lakes, caused general frosts, both light and killing, throughout the Ohio Valley and Tennessee, adjacent portions of the Lake region, the southern portions of the upper Mississippi and Missouri valleys, and portions of Mississippi and Arkansas. Northeast gales were reported on the Gulf coast from Galveston, Tex., eastward to Mobile, Ala., and still continued at the former. They had, however, subsided on the Lakes. Within the succeeding eight hours the pressure still further decreased, and at the afternoon report of the 12th the maximum was bounded by an isobar of 30.10, and covered mainly the Rio Grande Valley, southern slope, western Gulf states, southern portions of Missouri and Illinois, and the Ohio Valley and Tennessee as far eastward as the eighty-second meridian.

Its subsequent path cannot be definitely traced, but, apparently, the western portion of the area united with a higher area approaching from the northwest, while that part east of the Mississippi probably moved northeastward off the coast, as traces of its progress seemed apparent during the night of the 12th over northern Alabama, eastern Tennessee, and northeastward towards the coast of New England, where the attendant cool wave caused numerous local frosts. Gales had again set in on the Lakes, north of which another depression was then moving, and the passage to the south of this portion of the high area aided materially, in conjunction with another high pressure farther west, both in their production and continuance.

III.—Morning reports of the 12th indicated the presence of an area of high pressure in the western Saskatchewan valley. A depression then existed to the eastward over the lakes north of Manitoba. Moving southeastward the high area crossed the border and entered the northern slope on the afternoon of the 12th. Rains and southwest gales were reported from the Lake region, north of which the disturbance above referred to was then advancing. It continued its progress in the same direction, with but slight modifications in energy. After reaching the Mississippi River near the northern boundary of Iowa on the night of the 13th, it trended more to the eastward, and the gales and rains ceased as it approached the Lakes and as the disturbance passed to the eastward down the Saint Lawrence Valley. The temperature fell rapidly as it progressed across the Lake region, and on the night of the 14th numerous killing frosts were reported from Ohio, Pennsylvania, and western New York, where the temperature fell in many instances to 16° below the normal. Its path from the morning of the 15th, when it was central near the southeastern coast of Lake Erie, was more to the southward. It reached the New Jersey coast within the next sixteen hours, and during the succeeding night caused many local frosts from North Carolina northward over the coast region to New England. During the 16th it passed off the coast into the north Atlantic.

IV.—From the 14th to the 19th, inclusive, the pressure on the north Pacific coast was subject to marked fluctuations. Areas of comparative high pressure would frequently appear which would develop sufficient energy to force advance waves inland that would frequently cross to the eastern slope of the mountains and cause local frosts and rains, but no other marked weather modifications. At times the entire area would apparently advance in the same manner and eventually disappear before reaching the Mississippi, without showing a well-defined extended track or having any special apparent influence on the weather conditions generally, the pressure meanwhile on the coast having been materially re-enforced so as to form a new high area. On the night of the 19th, however, a comparatively well-defined area of high pressure, about .3 above the normal, advanced inland to eastern Oregon. Moving slowly to the southeast, it crossed the mountains, and on the morning of the 21st it covered the greater portion of the country from the mountains eastward to the Mississippi, except Montana, where the pressure had begun to decline in advance of a disturbance approaching from the northwest. Depressions of temperature of from 5° to 19°

occurred throughout the area, and killing frosts were reported in Kansas. High winds had attended the progress of a depression over the Lakes since the 19th, and still continued, apparently augmented by the advance of this high area. During the next sixteen hours it moved southward, with diminished energy, to the west Gulf coast in advance of a low area following from the Northwest. Trending afterwards to the northeast, it passed during the night of the 21st to the east of the Mississippi, covering the country from the Ohio River southward to the Gulf and eastward to the south Atlantic states and the borders of the Virginias, causing numerous local frosts therein and in northern Ohio and southeastern Wisconsin. Gales had abated on the upper lakes, but still continued at eastern ports on Lakes Erie and Ontario. It continued its progress towards the middle Atlantic coast, the gales abating on the lower lakes as it advanced, and during the 23d passed into the Atlantic, apparently still continuing its direction towards the northeast. Killing local frosts were reported in the coast regions of the middle Atlantic states and New England on the night of the 22d, where the temperature fell from 10° to 16° below the normal.

V.—Afternoon reports of the 22d showed a marked increase in pressure in the western Saskatchewan valley near the mountains. Snow was then falling in that region and along the valley to the eastward north of Montana, at numerous points in that territory, and in Dakota and the northern border of Nebraska, also at several stations in the upper Mississippi valley. Local rains were also reported from stations both in the Missouri and Mississippi valleys. A storm of considerable energy was then central over the middle slope. During the next sixteen hours the pressure continued to increase, and on the morning of the 23d the high area, bounded by an isobar of 30.6, .68 above the normal, was still central in the same region. Meanwhile the depression had progressed into the Mississippi Valley, where the minimum pressure was slightly over .5 below the normal. The gradients were therefore marked. Heavy rains prevailed near the centre of the disturbance and light local snows continued to the northwestward towards the region of high pressure. The cold wave accompanying the high area extended southward to Texas and Arizona and westward from the low area to the Pacific, except over portions of California, where the variations from the normal were slight. The temperature at Calgary, N. W. T., apparently near the centre of the high area, was reported at 6°, 33° below the normal, and killing frosts occurred both in Idaho and Oregon. During the next eight hours the area began to move to the southeast, and heavy gales set in on the Lakes. Crossing the northern slope, it moved thence eastward towards the southwestern coast of Lake Michigan, near which it was central on the afternoon of the 25th, without any marked change in energy. The high winds subsided over the Lakes as it progressed, and, as the low area travelled in advance, passed rapidly to the northeast. Its subsequent course was to the northeast over Michigan into Quebec, thence through southern Ontario, the northern portion of Maine, and New Brunswick to the Gulf of Saint Lawrence, which it reached on the night of the 26th. At this time, though the western limit of the nucleus of maximum pressure, represented by the isobar of 30.6, was adjacent to the western coast of the Gulf of Saint Lawrence, and the eastern boundary, represented by the same isobar, was probably not far seaward, yet the waves of high pressure in rear covered a vast extent of territory and extended in irregular loops southwestward to the middle and southern slopes and thence northwestward to the Pacific coast. As the main area moved farther eastward off the coast detached areas of comparative high pressure formed apparently in the broken waves in rear and gradually disappeared. The largest of these subordinate high areas, enclosed by an isobar of 30.30, extended, at the last report on the 27th, in a belt about three hundred and fifty miles wide from the southern slope northwestward to the eastern border of the north Pacific region, with the maximum pressure central in western Colorado. During the 28th the centre of this area moved north-

westward into Idaho and western Washington Territory, with slightly increased energy, and remained nearly stationary in that vicinity until the 29th, when it apparently became merged in a higher area moving southward from Manitoba.

The heavy gales produced on the Lakes by the passage of this high area in rear of a marked depression caused great loss of life and property, especially on Lake Michigan, and the cool wave which accompanied it was felt generally throughout the country, and did considerable injury.

VI.—This high area apparently approached northeastern Dakota and the adjoining border of Minnesota on the afternoon of the 28th from the British Possessions to the northeast of Manitoba. The general direction of the path of maximum pressure was to the southward down the Red River and Missouri valleys, and, early in its progress, its waves extended westward over the mountains so as to unite with the high area central in Idaho. As it advanced southward high winds arose on the Lakes, over which a depression had recently passed. Local rains and snows were also frequent over that region and extended northeastward as the depression moved seaward, and as the advance waves of the high area progressed eastward. At the last report on the 29th the centre of pressure, bounded by the isobar of 30.5, extended in the form of an ellipse from southwestern Colorado to western Wisconsin, the longer axis pointing to the northeast. Low areas at this time existed near Manitoba and on the coast of the Carolinas. A line drawn diagonally from Fort Garry, Manitoba, to Yuma, Ariz., approximately represented the isotherms of normal temperatures, those to the westward being above, and those to the eastward below the mean; depressions of 25° existed, in a few instances, near the centre of the high area, elsewhere they were not so marked. During the succeeding night the high area moved farther to the southward and slightly to the westward, causing local frosts in the lower Mississippi valley from Alabama northward, and in the western Ohio valley. The gales subsided on the Lakes and the precipitation generally ceased. During the 30th the pressure throughout the area decreased materially, and at the last report on that date the maximum, bounded by an isobar of 30.3, extended in a crude semi-ellipse from the western Gulf states and Rio Grande Valley northwestward into Utah and Wyoming. On the night of the 30th the cool wave extended eastward over the eastern Gulf and western portions of the south Atlantic states, causing numerous local frosts, both light and killing. The pressure throughout the area still further declined during the 31st, and at the last report of the month the isobar of 30.2, enclosing the maximum pressure, extended in a trough from the coasts of the western Gulf states and the Rio Grande Valley northwestward into Idaho and western Montana, apparently not specially affecting weather conditions in the vicinity.

Another area of comparatively high pressure was at the close of the month apparently central in the British Possessions to the north of Lake Superior.

AREAS OF LOW PRESSURE.

During the month eleven low areas, whose paths have been traced on chart i, have appeared within the range of observation, or sufficiently near to permit their approximate location. Eight of these were first observed in the Saskatchewan Valley, whence six passed to the Atlantic through, or adjacent to, the Gulf of Saint Lawrence, and the other two, it is believed, pursued approximately a similar course, although they moved into the British Possessions beyond the field of direct observation, one near the eighty-second, the other near the ninety-seventh, meridian. One low area apparently developed in the northern plateau, moved southeastward into Wyoming, where it divided, one subordinate depression passing to the Atlantic through the Gulf of Saint Lawrence, the other through Texas into Mexico. Two others, of cyclonic energy, moved from the Gulf of Mexico in a general northeastward direction, one of which united in Maine with a depression from the Saskatchewan Valley, passed northward and subsequently north-

eastward with it to the Gulf of Saint Lawrence; the other crossed the peninsula of Florida, and, moving approximately parallel with the coast, was central at the close of the month off the middle Atlantic states.

The mean direction of translation was slightly to the south of east, and the development or first location of the respective centres, and also their subsequent paths, farther to the north than usual.

The month in general has been particularly unfavorable to lake navigation. The paths of nine low areas (including the two above noted as having passed into the British Possessions) having either crossed or been sufficiently near the Lake region to have affected more or less seriously atmospheric conditions therein and endangered or caused the loss of many valuable lives and much property. Storms numbers i and viii were notably severe (see descriptions and extracts).

The following table furnishes interesting information relative to these areas of low pressure:

| Number of area. | First observed. | | | Last observed. | | | Average progress per hour. |
|-----------------|-----------------|---------|----------|----------------|---------|----------|----------------------------|
| | Date and time. | Lat. N. | Long. W. | Date and time. | Lat. N. | Long. W. | |
| I..... | 1, 7 a.m. | 52 00 | 107 00 | 6, 10 p.m. | 46 00 | 58 00 | 19.5 |
| II..... | 4, 3 p.m. | 51 00 | 110 00 | 6, 3 p.m. | 47 30 | 83 00 | 34.2 |
| III..... | 5, 10 p.m. | 44 00 | 115 00 | 12, 7 a.m. | 47 00 | 56 00 | 25.8 |
| III a..... | 6, 10 p.m. | 39 30 | 107 00 | 9, 3 p.m. | 26 30 | 100 30 | 23.4 |
| IV..... | 11, 3 p.m. | 52 30 | 109 00 | 15, 7 a.m. | 48 00 | 58 00 | 27.6 |
| V..... | 14, 7 a.m. | 51 30 | 115 00 | 18, 3 p.m. | 49 00 | 69 00 | 26.8 |
| VI..... | 17, 7 a.m. | 51 00 | 114 30 | 21, 10 p.m. | 49 00 | 68 00 | 23.5 |
| VII..... | 18, 7 a.m. | 52 00 | 114 30 | 21, 3 p.m. | 45 30 | 70 00 | 26.8 |
| VIII..... | 21, 7 a.m. | 51 00 | 115 00 | 24, 10 p.m. | 48 45 | 61 30 | 38.9 |
| IX..... | 27, 3 p.m. | 51 30 | 114 30 | 29, 10 p.m. | 47 00 | 61 30 | 48.2 |
| X..... | 28, 7 a.m. | 26 00 | 85 00 | 31, 10 p.m. | 38 00 | 73 30 | 18.2 |
| XI..... | 29, 3 p.m. | 53 00 | 112 00 | 30, 10 p.m. | 52 00 | 97 00 | 19.7 |

Average rate of progress, 27.9 miles per hour.

The low area referred to in last REVIEW as central at the close of September near Grand Traverse Bay in northern Michigan was, on the morning of the 1st, approximately in the same position. Moving subsequently northeastwards into the province of Ontario, it crossed north of the Lakes towards the Saint Lawrence Valley, down which it apparently passed into the Atlantic in advance of a lower area closely following. Frequent rains fell to the south of its path over the Lakes, northern New England, the Maritime Provinces, and in the valley during its progress. The high area which on the night of the 1st was adjacent to the coast of the Maritime Provinces, impeded somewhat its movement seaward. Gales on the Lakes did not immediately succeed its translation, owing to the rapid advance of a greater depression in rear, but those which set in after the passage of the latter were probably materially augmented by the proximity of this area to the eastward.

I.—Morning reports of the 1st indicated the presence in the Saskatchewan Valley, adjacent to the junction of the two main branches of the river, of a well-defined low area which had apparently during the preceding night moved eastward from the mountain slope. Conditions in advance were favorable for its rapid translation, as a depression existed over the Lakes and the pressure towards the Atlantic coast was below the normal, except in portions of New England and the Maritime Provinces, where it was rapidly declining. The low area moved eastward during the 1st towards the lakes north of Manitoba, but during the succeeding night trended more to the south, and on the morning of the 2d was central in Minnesota. Higher temperatures and local rains attended its progress. Its general subsequent direction was eastward into the province of Ontario until it reached the region to the north of Parry Sound, where its progress for sixteen hours, from the afternoon of the 3d to the morning of the 4th, was materially retarded. Changing its direction subsequently to the southeast, and moving more rapidly, it crossed the Saint Lawrence River near the eastern shore of Lake Ontario on the night of the 4th and, passing through New England, was central off the coast of New Hampshire at the last report on the night of the

5th. Afterwards, apparently, it moved off to the northeast along the coasts of the Maritime Provinces. Local rains attended its progress across the Lakes and on the coasts, and heavy gales on the afternoon of the 2d, and on the 3d and 4th, prevailed over the Lake region and caused many disasters to shipping and much loss of property. On the morning of the 3d, when the depression was central north of the Straits of Mackinaw, the pressure had reached the minimum observed during translation. A barometer reading of 29.26, .8 below the normal, was then reported from the station at Mackinaw City, Mich., and as an area of comparative high, nearly .1 of an inch above the normal, then existed to the southwestward, the gradients at that time and during the day were quite marked and the gales more than ordinarily severe.

The following extracts will show the severity of this storm:

DETROIT, MICH., October 4.—A special to the "News" from Marquette, Mich., says: The heaviest gale ever recorded at the Marquette signal station is still raging. It began Sunday noon, with a thirty mile wind from the southwest. It shifted to the west, and since midnight Sunday has averaged a velocity of thirty-eight miles an hour on the open lake. Four times yesterday the wind reached a velocity of forty-two miles at the station, or fifty on the lake. A terrible sea is running, and the wind at 1 p. m. was blowing thirty-four miles, with no sign of a break in the storm. The weather is thick.

On the 3d the wind increased in violence, blowing a gale from the northwest. Estimated velocity between forty and fifty miles per hour. The wind abated somewhat on the 4th, but continued to blow hard until sundown, when it died down.—*Mr. Geo. L. Collie, voluntary observer, Delavan, Wis.*

The westerly gale hauled to the northwest and moderated some at Chicago, but the wind is still blowing fresh from that quarter. Early in the morning the wind was raging with unabated violence in the vicinity of the straits, where the velocity was forty-eight miles an hour. The storm was central over Georgian Bay, and heavy winds prevailed throughout the lower lake region. Very few vessels reached here during the day, but all that did bore marks of rough usage outside. From the reports of vessel captains the storm was far more terrible on Lake Michigan than those who were safely ashore can realize. The steamer "Jewett," which was never known to turn tail in a gale of wind, bucked against the wind and sea at the foot of the Lakes for six hours without making any perceptible headway.—*Chicago Tribune, October 5th.*

The observer at Mackinaw City, Mich., reports that the propeller "California," bound from Chicago to Montreal, foundered off the island of Saint Helena at 1.30 a. m. on October 4th. She was laden with 700 barrels of pork and 20,000 bushels of corn, and went down in about fifty feet of water. Nine lives were lost; the vessel went to pieces and will probably prove a total loss.

At midnight the tug "Green" left for the lake and this morning picked up the schooner "Canton," ore-laden, from Escanaba, and though only drawing twelve feet of water she dragged along the bottom, and few tugs other than the "Green" could have brought her in. Captain Berlin, of the "Canton," reports a fearful experience on Lake Huron. He came down the lake in a tow of six vessels. Sunday night tow broke loose from the tug and went adrift. For twenty-four hours immense seas broke over the staunch little vessel but she weathered it bravely and reached the rivers in good time and safe.—*Toledo Bee, October 4th.*

Yesterday afternoon Messrs. Sullivan and Hubbard, of this city, received a dispatch stating that the schooner "Pulaski," owned by them, while on the way from Sandusky to Manitowoc, coal-laden, had gone ashore during the storm and was a total loss. Capt. P. J. La Vow, in a dispatch, says the schooner had been run close to shore and anchored, but the heavy wind dragged her ashore, where the heavy seas soon tore her to pieces.—*Toledo Bee, October 5th.*

CLEVELAND, OHIO, October 4th.—Sunday night and yesterday violent westerly gales succeeded one another in such quick succession as to be almost a continual hurricane. Trees, signs, chimneys, and roofs suffered, but no serious damage was done here.—*Portland (Me.) Daily Press.*

ERIE, PA., October 5th.—A two-masted schooner went ashore at Ripley shortly before dark last evening. The gale raged furiously all the afternoon. The last seen of the craft there were six men in the rigging. The United States revenue cutter "Perry" went to the rescue, but, on account of the darkness, it is feared that the men were not saved. The name of the schooner is not known. Several tugs which ventured to go to the relief of the vessel were obliged to put back.—*Toledo Bee.*

A gale began at 5.10 p. m. on the 2d and ended at 5.45 p. m. on the following day; maximum velocity of the wind, forty-eight miles per hour, from the west, was recorded at 10.52 p. m. on the 2d. A similar velocity was also recorded from the northwest at 12.42 p. m. on the 3d.—*Observer, Milwaukee, Wis.*

A heavy gale prevailed during the day of the 4th; schooners "City of Green Bay" and "Havannah," from this port, were lost in the gale, with nine seamen. The vessels and cargo are valued at \$30,000. The storm is reported to have been the most violent of the season.—*Observer, Escanaba, Mich.*

A gale began about midnight on the 2-3d, and continued high all day, reaching its maximum velocity, thirty-five miles per hour, at 12.10 p. m. Some trees were blown down, and the high smoke-stack of State Printing House was blown over.—*Observer, Lansing, Mich.*

A severe gale set in from the southwest at 7.27 a. m. on the 3d, and con-

tinued throughout the day. The lake at this port was very rough, submerging both breakwaters, and at times the water was forced above both light-houses; the breakwaters sustained heavy injuries. Buffalo River rose seven feet during the storm, flooding a number of houses, and on the island and along the water front numerous families were obliged to vacate their homes. The New York Central Railroad was compelled to keep trucks on the tracks in order to protect them from destruction. Barge "C. L. Hutchinson" ran ashore about ten miles from this city with a cargo of 35,000 feet of lumber; the vessel became a total wreck, but the crew were saved. Considerable damage was done in this city; trees, signs, fences, cornices, chimneys, and roofs being carried away by the wind. Sea captains state that this was the most severe and destructive storm that has ever visited the Lake region so early in the season.—*Observer, Buffalo, N. Y.*

II.—This disturbance was first definitely located on the morning of the 4th, north of Montana, near the south branch of the Saskatchewan River. During the next eight hours the pressure in that vicinity declined rapidly, probably owing to the approach of the area from the northwest beyond the limits of observation. Subsequently, however, during the day the centre of the depression apparently moved to the eastward, with decreased energy. As it approached the lakes north of Manitoba it trended southeastward in the form of a trough and covered western Minnesota. Moving farther southward it was central over Iowa and southern Minnesota at the last report on the 5th, but during the succeeding night moved northeastward towards the eastern portion of Lake Superior. Its subsequent course cannot be definitely traced, as it passed into Canada beyond the regions of observation. Its approximate course was apparently, however, northeastward towards the northern coast of the Gulf of Saint Lawrence, as a low area (most probably this one) was observed in that vicinity on the 7th, 8th, and 9th, passing seaward; local rains were also prevalent throughout the Lake region and northeastward towards the Gulf on the 5th and 6th, and in portions of the Maritime Provinces on the 7th, apparently attendant on the passage of a depression to the northward. Directions of wind and records of atmospheric conditions in these regions also pointed to the same conclusion.

III.—Night reports of the 5th seemed to indicate the development of a disturbance near Boise City, Idaho. The pressure at that time over the entire country was below the normal, ranging from about .06 below the mean to .46. Local rains were falling in northern California and the coast regions northward. Eight hours afterwards a well-defined depression existed in the form of a narrow trough, extending from about the middle of Utah northward into northern Montana, averaging about .6 below the normal. During the rest of the day the centre of the depression moved southeastward, with increased energy and contracted limits, into western Colorado, where, on the night of the 6th, it was located as a small oval, pointing approximately east and west. Rains had generally ceased, but had extended inwards from the coasts over the mountains and slopes to the north of the disturbance, and also into portions of the Missouri and Mississippi valleys. A high southeast wind was reported at Corpus Christi, Tex., and a maximum velocity of thirty miles from the same direction during the previous eight hours. During the succeeding night the depression seemed to divide, two separate nuclei being apparent on the morning of the 7th, one central on the borders of Colorado and Kansas, with a pressure about .6 below the normal; the other near Prescott, Arizona, .76 below the normal. During the day the northern centre of depression moved northeastward, with diminished energy, to the neighborhood of Saint Paul, Minn., and the southern, eastward into New Mexico. Rains generally prevailed from the Mississippi westward to the mountains, and had fallen at many lake ports. Snows also were reported at a few stations in the northern slope. Gradients were close near both depressions. High southeast winds continued at Corpus Christi, Tex., and winds were beginning to freshen on the upper lakes and had in a few instances already reached velocities dangerous to navigation.

During the 8th the northern depression moved southward from near Saint Paul, Minn., through Iowa into northwestern Missouri, and afterwards changing direction to the northeast

during the succeeding night crossed Wisconsin and reached the northern coast of Lake Michigan on the morning of the 9th. Copious rains attended its path both in the valley and near the upper lakes. Its general course subsequently was eastward, north of the Lakes, towards the Saint Lawrence and down the adjoining valley to the sea. Abundant rains fell along its path and to the southward, and high local winds were reported from lake stations on the 10th and 11th. As it approached the Gulf of Saint Lawrence its energy seemed to increase, and it passed into the Atlantic on the 12th, apparently as a well-developed low area. The southern depression, which at the last report on the night of the 7th was central in New Mexico, moved eastward during the next sixteen hours into northwestern Texas, thence trending southward it crossed the Rio Grande on the morning of the 9th, and passed southward into Mexico, being approximately central to the west of Rio Grande City, Tex., at the afternoon report of that date. It was accompanied by local rains in the vicinity of its path, and by gales on the Texas coast near Corpus Christi, which subsided during the 8th.

The future course of this disturbance is a question for consideration. A low area appeared on the morning of the 10th to be approximately central near the Mexican coast and subsequently seemed to move eastward into the Gulf near the twenty-fifth parallel. This may possibly have been the same disturbance, which perhaps trended to the east in Mexico and passed into the Gulf.

IV.—This low area was first observed near the north branch of the Saskatchewan River west of the one hundredth and seventh meridian on the afternoon of the 11th. It moved southeastward with comparatively feeble energy, reaching the lakes north of Fort Garry, Manitoba, on the morning of the 12th. Afterwards it crossed the province of Ontario north of the Lakes, influenced by the higher pressure to its south, entered the Saint Lawrence Valley and passed into the Gulf across the northern border of New Brunswick on the morning of the 14th. Twenty-four hours afterwards it was apparently central on the southern coast of Newfoundland, passing seaward. High winds and dangerous local gales occurred in the Lake region on the 11th, 12th, and 13th, and also on the coasts of New England on the last date, during its progress to the north and east of these regions. Light rains fell along its path and in the vicinity southward. The depression had apparently attained its maximum energy on the afternoon of the 12th, when it was central north of Lake Superior, with a pressure about .6 below the normal. Within the succeeding eight hours, however, its energy declined materially and the pressure increased nearly .2. As it approached the Gulf there was a further decline in energy, and when it left the coast it was apparently but a slight depression of comparatively little magnitude and feeble force.

V.—Morning reports of the 14th indicated the presence of another depression in the western Saskatchewan Valley adjacent to the mountain slope. During the next sixteen hours it moved in a direction slightly south of east and reached the vicinity of the one hundred and fourth meridian. Thence it trended more to the southward, crossed Dakota, and passed into western Nebraska, where it was central on the afternoon of the 15th, resembling in general outline an ellipse with the major axis pointing northeast. Light local rains had fallen on the mountains to the westward and in the Missouri and Mississippi valleys. High winds were reported both on Lake Superior and in northern Michigan. An area of comparatively high pressure was then central southeast of Lake Ontario, influencing atmospheric conditions westward towards the depression, and probably materially modifying its path. During the next eight hours the centre of the depression moved southeastward through Nebraska to the vicinity of the Platte River. Thence it moved northeastward into southern Minnesota, with diminished energy. Trending afterwards to the southeast it crossed the Mississippi north of Dubuque, Iowa, on the afternoon of the 16th and passed northeastward into the province of Ontario

across the intervening states and lakes. Moving eastward afterwards to the valley of the Saint Lawrence it passed down to the vicinity of Father Point on the afternoon of the 18th, and, changing its direction more to the northward, advanced into the province of Quebec beyond the limits of observation. Local rains, generally light, fell in the Lake region during its progress there, and while to the northward, and also in the valley portions of New England and the Maritime Provinces. Local gales of moderate force, mainly from the southwest quadrant, were reported at a few lake ports on the 15th, 16th, and 17th.

This depression was at its maximum when in the valley north of Montana, where the pressure was a little over .6 below the normal. Its energy during translation was at no time specially marked, and materially decreased when it passed to the east of the Mississippi.

VI.—On the morning of the 17th the disturbance which had apparently for several days been indicated to the south of the Gulf coast of the United States seemed to be approximately located off the coast of Mexico, south of the mouth of the Rio Grande. Frequent rains had fallen during the preceding twenty-four hours at stations on the coasts of Florida, and on the Gulf westward, and still continued. The pressure at Brownsville, Tex., the station nearest the centre of disturbance, was about .2 below the normal, and still decreasing. An area of comparatively high pressure was in the northern plateau region, and another, which had been for about thirty-two hours approximately central on the New England and middle Atlantic coasts, and which had probably materially modified the movement of this low area, had recently moved seaward. Moving approximately northeastward towards the mouth of the Mississippi the disturbance approached the Louisiana coast with cyclonic energy and reached the vicinity of New Orleans, La., on the morning of the 19th. A barometer reading of 29.22, .82 below the normal, was reported from that station on that morning, which represented a fall of .52 during the preceding eight hours. Gales of hurricane force from northeast to northwest had prevailed on the west Gulf coast on the 18th, but had subsided, except in the immediate vicinity of the depression, where gradients had become quite marked, averaging about one-tenth in thirty miles between New Orleans, La., and Mobile, Ala. Passing to the southeast of New Orleans the centre of the storm moved northeastward into Alabama on the 19th, accompanied by heavy gales and rains.

Storm signals had been ordered well in advance, and the public had been fully advised both of the approach of the storm and its probable direction. Much damage, however, was done to shipping in the Gulf, especially in the vicinity of New Orleans, La., and Pensacola, Fla., where the gale was unusually severe. On the 19th a maximum velocity of forty miles was reported at Galveston, Tex.; forty-two miles at New Orleans, La. (between 8 and 9 a. m.); forty-eight miles at Pensacola, Fla.; and fifty miles at Mobile, Ala. Minor damages, besides, occurred in that vicinity, such as the prostration of telegraph wires, trees, fences, etc. During the afternoon and night of the 19th the central pressure materially increased and the energy declined as the low area progressed northeastwards towards the coast of North Carolina, which it reached on the evening of the 20th. Trending afterwards more to the north, it passed, with increased energy, into the Atlantic, and moving adjacent to the coast crossed southeastern Massachusetts and entered New Brunswick, where it was joined on the evening of the 21st by another low area, number vii, approaching from the west. The combined area advanced thence northward with marked energy, crossed the Saint Lawrence near Father Point and apparently passed off into the British Possessions to the northeastward.

The gales subsided on the Gulf coasts during the night of the 19th, but set in during the succeeding day on the coast of the south Atlantic states, and subsequently northward as the storm advanced. Prominent eastern seaports had been fully apprised by the display of signals and bulletins, and also

through the press, of the advance and probable severity of the storm, yet as many vessel owners choose to take the risk, and numerous vessels were en route on their respective voyages, much damage and many minor disasters resulted, as the gales, especially on the middle Atlantic and New England coasts, and also in the Gulf of Saint Lawrence, were very severe. Maxima velocities ranged on the Atlantic coasts from forty to fifty miles. General rains fell along and adjacent to the path of the depression.

The following extracts from the reports of observers, and items from the public press, refer to this storm:

New Orleans, La.: heavy rain began at 12.30 and ended at 10 a. m. on the 19th, it recommenced at 1.20 and ended at 2.30 p. m.; total amount of rainfall during the storm, 2.19 inches; high wind prevailed during the storm, reaching a maximum velocity of forty-two miles per hour from the north at 8.35 and 8.45 a. m.; the wind storm ended at 3.17 p. m.

NEW ORLEANS, LA., October 19.—The heaviest rain of the year fell last night, and the barometer reached a lower point than is on record since the establishment of the signal service station here. It rained nearly all day and all night, the fall being registered at two inches. The rear of the town was flooded. The fires at the draining canal were put out by the flood. The draining canals were bank full, and the level for some hours was several feet higher in the rear than the front of the town. Thousands of acres of cane, ready for cutting and grinding, were beaten to the ground by the mud and rain, and cotton not yet picked was trodden down in the mud. In the city proper the frame-work of the new Catholic church of Our Lady of Good Council, in the sixth district, was blown down, and the Rev. Father Lambert caught in the timbers and painfully bruised. The floating grain elevator, "Jennie Armstrong," had her top-works blown away, involving a loss of \$10,000. The roof of the cotton mill of Lehman & Abrams, and the machinery, are drenched with the flood. The Louisville and Nashville Railroad line near Lake Catharine again suffered, some two or three hundred feet of track being washed out. Electric light wires were thrown from their fastenings and five buildings in different parts of the city were set on fire thereby. Hundreds of trees throughout the city were uprooted and fences blown down. No lives were lost, but there were many narrow escapes. The wind reached a velocity of forty-eight miles an hour.—*Chicago Tribune*, October 20th.

Pensacola, Fla.: a heavy gale prevailed during the 19th, maximum velocity forty-eight miles per hour from the southwest; the high wind caused some damage to telegraph lines, and all telegraphic communication was cut off. Lumber merchants who did not take precautionary steps to save their lumber lying in the bay lost it all.

New York was caught right between the teeth of two cyclones yesterday. It got badly bitten. One cyclone came up from the balmy South, as was predicted by the "Herald" yesterday. It raised havoc all day yesterday and did lots of damage and created a good deal more fear. The other cyclone came from the Northwest, where they always keep them on tap, and enhanced the racket.

On Thursday all the steamship officers were warned not to send out southward bound vessels. Some sailed, however, despite the warning. The "Newport," of the Pacific Mail Steamship Line, was one of the vessels that went out. Her captain thought that he could avoid the storm by hugging the coast. The vessel was supposed to be about off Cape Hatteras last night, and it was feared that she has had a pretty rough time of it. The "City of Pueblo," for Valparaiso, was to have sailed yesterday, but her captain, being impressed with the value of the warning, delayed the time of her departure until this morning. The "City of Atlanta" went out, but her captain thought he could dodge the storm. The skippers of a score of smaller craft that went out were of the same opinion, and believed that the storm would pass out to sea before they could encounter it. It is feared that to-day will tell a sad tale of wreck all along the coast, and with it the contingency of a loss of life.

At 10 p. m. on Thursday the steamer "Charles F. Mayer," a collier, bound from Boston to Baltimore, went ashore on the Jersey coast, near Chadwick. The point where she stranded was about half a mile south of Life Saving station No. 12. Keeper Petit, in command of the station, and his men took the crew of seventeen ashore by means of the breeches buoy. Surfman Benjamin Truax discovered the stranded vessel in the midst of a terrible storm. Signal lights were at once burned and the mortar hauled out on a cart to the beach. A line was fired and landed over the ship at the first attempt. The arrangements were quickly made and the men hauled ashore through the seething and booming surf. The vessel is high and dry and can easily be hauled off as soon as the storm subsides.—*New York Herald*, October 22d.

CHATHAM, MASS., October 21st.—The steamer "Alleghany" struck something off West Chop and ran ashore to keep from sinking. The cargo is in a dangerous condition. Eight passengers are on board and are all well; they will be sent ashore at the first chance. The ship is damaged forward.

NEW YORK, October 21st.—The cyclone that has played havoc in the South was off Virginia at 7 o'clock this morning. The vessels which left this port for the South yesterday are very likely to run into the storm. They were the "Newport," for Aspinwall, "City of Atlanta," for Savannah, "New York," for Galveston, "City of Savannah," and "Richmond," for Newport. A high wind prevails this afternoon.—*The Palladium*, Oswego, N. Y., October 21st.

Block Island, R. I.: light and heavy rains prevailed during the forenoon up

to 11.20 a. m. on the 21st. High southeasterly winds began during early a. m. and, shifting to north at 10.45 a. m., attained a maximum velocity of forty miles per hour from the last-mentioned direction. Several disasters occurred during the gale. Schooner "Rose Bros." broke from her moorings at 4 a. m., but was saved by the life-saving boats. Schooner "Mystery" parted her cables at about 6 a. m. and was driven against the breakwater and damaged.

VII.—This disturbance was first definitely located near the sources of the Saskatchewan River on the mountain slope north of western Montana on the morning of the 18th. Gradients of pressure southward were marked, as a comparatively high area then existed from the Missouri River westward to the middle Pacific coast. Moving with high energy the centre of the depression passed to the southeast, advanced across the northern portion of Lake Superior, through southeastern Ontario and the adjoining border of Quebec, crossed the Saint Lawrence northeast of Montreal, passed through northern Maine into New Brunswick on the 21st, and united with low area number vi advancing from the southward. The subsequent course of the combined area has been described in connection with the preceding low area. Local rains fell along the path of the depression and to the southward, and heavy gales, mainly from southwestern and northwestern quadrants, occurred in the Lake region during its passage to the northward and eastward. The central pressure, which on the night of 18th was apparently at its minimum, when the depression was north of eastern Montana, was slightly over .8 below the normal, but as it passed to the east of the lakes north of Manitoba its energy declined somewhat, though throughout its entire path it was comparatively high.

Observers report as follows, relative to this disturbance:

Fort Custer, Mont.: light rain fell during early morning on the 19th, and high winds prevailed from 12.42 to 2.42 a. m., and from 10.21 a. m. until 6 p. m.; a maximum velocity of fifty miles per hour from the north was recorded at 1.45 a. m. No serious damage has been reported.

Marquette, Mich.: a heavy wind storm commenced at 10.20 a. m. on the 19th; registering a maximum velocity of thirty-six miles per hour from the southwest at 11.59 a. m.; a similar velocity was recorded from the south at 3.27 and at 4.41 p. m.; the gale ended at 5.28 p. m.

Columbus, Ohio: a westerly gale began at 1.30 a. m. on the 21st and lasted fifteen minutes, the wind attaining a maximum velocity of thirty miles per hour at 1.40 a. m. Another gale began at 9.25 a. m. and ended at 4.05 p. m., reaching a maximum velocity of forty-two miles per hour at noon. The damage done by the high wind was slight.

Erie, Pa.: high westerly winds prevailed all day on the 21st; maximum velocity, forty miles per hour from the northwest at 10.07 p. m. A high northwesterly gale prevailed all day of the 22d; maximum velocity, thirty-six miles.

Buffalo, N. Y.: a gale set in from the west at 3.18 p. m. on the 21st and continued until after midnight. A maximum velocity of thirty-eight miles per hour from the west was recorded at 10.25 p. m.

Oswego, N. Y.: a storm began 7.20 p. m. on the 21st and increased in force until early morning of the 22d, when a velocity of thirty-six miles per hour was recorded several times from 3.25 to 5.50 a. m.; a maximum velocity of forty-eight miles per hour was also recorded within the above-mentioned time. Rain and sleet fell at intervals during the 22d. The storm ended at 5.30 p. m. on that date. The water in Lake Huron was very rough during the storm. The schooner "Delaware" had some of her sails carried away.

The presence of a depression was indicated off the Carolina coasts on the afternoon and night of the 18th. Heavy local rains then prevailed there and in southern Virginia, and subsequently extended northeastward as the disturbance progressed apparently in that direction. On the afternoon of the 19th it was approximately off the coast of southern New England, causing high local winds on the southern shore of Massachusetts. For further information relative to this storm see description of depression number 11 under "North Atlantic storms of the month" in this REVIEW.

VIII.—Morning reports of the 21st showed the presence of another low area in the western Saskatchewan valley, slightly to the southwest of the location where the preceding area was first observed. Moving southeastward, with increasing energy, into northwestern Indian Territory, which it reached on the night of the 22d, it changed its direction to the northeast and, progressing rapidly, crossed Lake Michigan on the afternoon of the 23d, reached Georgian Bay within the succeeding eight hours, and passed speedily down the Saint Lawrence Valley to the Gulf, where it was central to the east of Anticosti on the night of the 24th, and thence passed seaward, apparently

over Newfoundland. This depression moved with marked rapidity, its average velocity over the path of about 3,420 miles being 38.9 miles per hour. The rapid translation was probably materially due to the swift approach of a marked high area in its rear, and the comparatively low pressure over the Lakes and northeastward in its advance. Its energy was at the maximum on the afternoon of the 23d, when in northern Michigan, between the Lakes; the central pressure at the time being of contracted area, and about .7 below the normal. Precipitations were general along, and near, its path. Rains were most frequent, but light snows were also numerous, caused by the rapid advance of the cold wave accompanying the high area in rear. Violent local gales, mainly from sw. and nw. quadrants, occurred on the Lakes on the 23d and 24th, and were accompanied by rain and snow-squalls, which still further tended to endanger life and property. Shipping generally seems to have suffered much damage, and considerable loss of life is also reported.

The storm seems to have been unusually disastrous, especially in the Lake region. Heavy gales also prevailed on the New England coasts on the 24th, and in the Gulf of Saint Lawrence and adjacent regions on the 25th and 26th.

The following extracts, from the reports of observers, and from other sources, will show the extent and marked severity of this storm:

Saint Louis, Mo.: a severe gale, accompanied by light rain, occurred from 10.40 to 11 a. m. on the 23d, the maximum velocity of the wind, sixty miles per hour, was reached at 9.46 a. m.

Cairo, Ill.: the high wind on the 22d, with maximum velocity twenty-nine miles from the south, troubled all the Western Union wires between this city and Saint Louis, Mo., and it was with great difficulty that any message could be transmitted between these points. Steamers on the Mississippi River experienced much difficulty in making their landings, the river being very rough. High winds occurred also on the 23d and 24th; maximum velocities of thirty and thirty-two miles per hour from the north were recorded on these dates, respectively; high northerly winds prevailed during the morning of the 24th, with a maximum velocity of forty miles per hour from the north; steamer "Belle Memphis" was driven ashore and delayed ten hours.

Chicago, Ill.: brisk and high east to west winds and cloudy weather prevailed during the 23d, with light rain in the forenoon. The gale caused much damage to trees, signs, and in some cases to buildings.

Milwaukee, Wis.: a storm began to blow from the southeast at 11.05 p. m. on the 22d and ended at 8.15 a. m. the following day; maximum velocity of the wind, thirty-five miles per hour, from the southeast, occurred at 4.12 a. m. on the 23d. This storm was the most severe of the season at this port, and the first one with an on-shore wind. A large number of vessels sought shelter in the harbor. Schooner "Maine" dragged her anchor and was driven ashore near the harbor piers at 4 a. m. on the 23d. The vessel will be a total loss, but the crew was rescued by the Life-saving Service. Another gale began at 2.05 p. m. and continued until 7.10 p. m. on the 23d; maximum velocity, forty-eight miles from the northwest, occurred at 4.22 p. m.

Grand Haven, Mich.: brisk southeast, shifting to colder southwest and northwest, winds prevailed during the day up to 4.50 p. m. on the 23d, when the storm attained its maximum velocity, fifty-four miles per hour; light rain began at 7.45 p. m. and changed to sleet at 11 p. m. on the same date. The steam barge "Argonaut," iron-ore laden, from Chicago, blew her signal of distress when about two miles from shore at about 3.30 p. m. on the 23d. The life-saving crew went to her assistance, but, owing to the fury of the gale and high sea, they were unable to render any assistance.

Mackinaw City, Mich.: a gale began 3 a. m. on the 23d and ended 7.42 a. m. on the 24th; the maximum velocity of wind, fifty-seven miles per hour, from the east, occurred 5.05 p. m. on the 23d. Another gale occurred from 8.45 p. m. of the 24th to 3.04 a. m. on the following day. It reached a maximum velocity of thirty-two miles per hour from the west at 10.35 p. m.

Marquette, Mich.: a severe wind storm, accompanied by a heavy fall of snow, set in 7.08 a. m. on the 23d; the water in Lake Superior was very rough, the waves reaching a height of from fifteen to twenty feet. A maximum wind-velocity of thirty-two miles per hour, from the east, was registered 10.06 a. m., and from the northeast at 12.58 p. m. The schooner "Geo. Sherman" became a total wreck on the south shore of Shot Point, twelve miles from Marquette, and the schooner "Alva Bradley" ran ashore near this city, but was saved by the Life Saving Service from Houghton; both schooners were laden with coal; loss about \$12,000.

Port Huron, Mich.: a severe gale began 5.10 p. m. on the 23d and ended 9.15 a. m. on the following day. A maximum velocity of fifty-five miles per hour from the southwest was recorded at 8.40 p. m. on the 23d.

Lansing, Mich.: a brisk southwest wind, shifting to south, prevailed during the forenoon of the 23d. At 3.30 p. m. the wind increased in force, reaching a maximum velocity of forty-two miles per hour, from the southwest, at 7.50 p. m., and continued high until midnight. From 6 to 10 p. m. the wind averaged over thirty miles per hour.

Toledo, Ohio: fresh to brisk winds prevailed, at intervals, during the 23d. At 1.30 p. m. it increased in force and remained high during the afternoon, reaching a maximum velocity of forty-four miles per hour, from the west, at 9.40 p. m.; at midnight the gale calmed down to twenty-five miles per hour. The three-masted schooner "Zach. Chandler" ran ashore at 10 p. m., opposite Noble Station, near this port; she was bound from Ashtabula to Escanaba, with coal; no loss of life.

Columbus, Ohio: a severe wind storm began 1.50 p. m. on the 23d, heavy gusts of wind tore over the city, carrying away roofs, signs, fences, and breaking hundreds of panes of window glass. At 5.15 p. m., while the gale was at its height, the Welsh Congregational church, a new and substantial structure, collapsed and became a total wreck; the loss is estimated at \$20,000. Several persons were injured by flying debris; maximum velocity of the wind, forty-eight miles per hour from the south, at 5.15 p. m.; the gale ended at 12.30 a. m. on the following day.

Erie, Pa.: unusually high winds prevailed during the day of the 24th, reaching a maximum velocity of forty-eight miles per hour at 1.25 a. m. on the 25th. Steam barge "J. S. Fay," of Cleveland, loaded with coal, became disabled by the rough sea, but was saved by the Life Saving Service. It is reported that the damage to vessels during the storm was very large.

Buffalo, N. Y.: an unusually destructive storm began during the night of the 23d-24th, the wind reaching a velocity of sixty-six miles per hour at 1 and 2.40 a. m., respectively. From 1 to 3 a. m. the wind record registered one hundred and fourteen miles, averaging fifty-seven miles per hour for two full hours, and from midnight until 6 a. m. an average velocity of fifty miles per hour had been recorded. The high wind caused considerable damage in the city, trees from twelve to fifteen inches in diameter were blown down; the streets were strewn with signs, fences, shutters, telegraph and telephone wires and poles; skylights, show-cases, and windows suffered seriously from the gale. A house in course of construction was blown down at 3.20 a. m., but no one was hurt. Captains, owners of vessels, insurance men, and others, acknowledged the great service rendered by the Signal Service in giving timely warning. Not a vessel of any kind left the port from 10 a. m. on Sunday the 23d until sundown on Monday the 24th. The disasters on Lake Erie were very numerous.

Oswego, N. Y.: a severe storm began at 10.30 p. m. on the 24th and increased steadily in force until 5.23 a. m., when a velocity of fifty-three miles per hour, from the west, was recorded; the storm ended at 8.10 p. m. No vessel left the port during the storm. Schooner "Annie Minnies" arrived at about 8 a. m. with her sails damaged. Trees and fences, and a new building used as a carpenter shop, were blown down.

Lunenburg, Vt.: high wind prevailed from 10 a. m. until 1 p. m. on the 24th. Numerous trees were blown down, and some damage was done to fences and buildings.

Boston, Mass.: brisk southwest winds, changing to west, prevailed during the forenoon on the 24th, reaching a maximum of forty miles per hour from the southwest at 12.10 p. m., after which time the wind gradually moderated.

MONTREAL, October 24th.—The severest gale ever known here has been blowing for the last twelve hours. At 2.30 o'clock it was blowing at eighty miles an hour. Four houses were blown down on St. Dominique street, and a block of forty houses was destroyed by fire. In St. Jean Baptiste ward large trees have been rooted up, walls and fences blown down, and considerable damage done.—*Chicago Daily News.*

NEWPORT, R. I., October 24th.—Intelligence was received here this morning that the United States training ship "Portsmouth," which left here yesterday morning, is on Point Judith with four anchors out. The wind is blowing a gale from the southwest directly on shore, and if the gale continues the ship can hardly escape going ashore, with a large loss of life, as the point is a dangerous one, and there are several hundred souls on board. [Later.] The imperiled schoolship was not the "Portsmouth," but the "Saratoga." The wind got around to the northwest and the "Saratoga" got up anchor and started for New York.—*Portland (Me.) Argus, October 24th.*

PROVINCETOWN, MASS., October 24th.—Wind westerly here to-day, blowing fifty miles an hour. The mackerel fleet all returned for a harbor.

SANDWICH, MASS., October 24th.—A regular equinoctial gale has prevailed from the southwest over the Cape since 3 o'clock. No damage reported as yet on the upper end of the Cape. The gale is the severest this season.—*Portland (Me.) Argus, October 25th.*

IX.—The low area which for about thirty-two hours seemed to have been either approaching or developing in the British Possessions to the north of Montana had on the afternoon of the 27th apparently formed a nucleus on the mountain slope, near the sources of the Saskatchewan. Within the next eight hours the centre of the depression moved rapidly a little south of east and, trending afterwards more to the south, entered northern Minnesota and advanced southeastward towards the eastern coast of Lake Erie, where it arrived on the morning of the 29th. Changing direction subsequently to the northeast, it passed, with increased velocity, during the next sixteen hours through northern New England and New Brunswick into the Gulf of Saint Lawrence. The central pressure of this low area was but slightly below the normal during its entire path, but after reaching the vicinity of the Lakes it was succeeded by a

high area rapidly advancing in its rear which considerably accelerated its motion and, as the equilibrium of pressure was still further impaired by a low area on the southeastern coast, the gradients over the Lakes became close, and heavy local gales again prevailed on the 28th and 29th in that region. Local rains and snows also attended the passage of this depression and further increased the dangers of navigation on the Lakes. The movement of this low area across the country was very rapid, its path, of about 2,700 miles, having been traversed at an average speed of about 48.2 miles per hour.

X.—The low area which had for several days been indicated as in the Gulf of Mexico, beyond the limits of observation of adjacent coast stations, was on the morning of the 29th approximately located off the southwestern coast of Florida, about two hundred miles to the northwest of Key West. Local rains had been frequent in the Rio Grande Valley, Gulf States, and Florida since the 24th. A high area was now advancing southward near the Mississippi. Crossing the Florida Peninsula during the next eight hours the centre of the disturbance trended more to the northward and, moving approximately parallel with the coast and at a comparatively short distance from it, progressed northeastward. The rains in the Gulf ceased after its advance into the Atlantic, but extended northeastward along the coast as the disturbance moved in that direction. It apparently increased in energy during translation and was accompanied by heavy gales, especially on the coasts of North Carolina and Virginia. In the vicinity of Norfolk, Va., the storm seems to have been especially severe on the 31st and to have caused much general damage. At the last report of the month the depression was apparently central off the coasts of Delaware and Maryland. Its energy was perhaps at its maximum when off the Virginia coast on the afternoon of the 31st. The pressure at that time at Norfolk was .56 below the normal, but was probably much less nearer the centre.

Observers in North Carolina and Virginia make the following reports regarding this storm:

Hatteras, N. C.: a storm began 4.05 a. m. and ended 2.20 p. m. on the 31st; a maximum velocity of fifty-four miles per hour from the north was recorded at 4.22 a. m.

Kitty Hawk, N. C.: rainy and brisk northerly winds becoming high, with a maximum velocity of sixty miles per hour, at 10.15 p. m. on the

30th. A severe rain and wind storm prevailed until 2 p. m. on the 31st, and for seven hours, from 4 until 11 a. m., the wind velocities averaged over sixty miles an hour; at 10 a. m. the storm attained its greatest force, the wind then reaching a velocity of seventy miles per hour. Considering the severity of the storm, very little damage was done in this vicinity.

Lenoir, N. C.: light rain prevailed at 8 a. m. on the 30th, it was accompanied by hail for a short time in the afternoon, and a few flakes of snow fell.

Raleigh, N. C.: a heavy rain storm began during the night of the 30–31st and continued until 1.10 p. m., when hail fell for about ten minutes. It again turned to heavy rain and was accompanied by snow from 6.30 to 8.30 p. m., when heavy rain set in anew and ended at 10 p. m., 4.18 inches of rain and melted snow having fallen during the prevalence of the storm.

Chicamacomico, N. C.: a heavy gale from the east, accompanied by a few claps of thunder, prevailed during the early morning of the 31st. The storm prostrated several telegraph poles on Body Island and south of Little Kinna-keet, cutting off telegraphic communication.

Cape Henry, Va.: a violent wind, rain, and sand storm prevailed during the day of the 31st. During the storm four schooners were driven ashore at different points between this place and Dam Rock, Va., and many vessels around the capes are still in danger; two lives are reported to have been lost. The wires between this point and Norfolk are in trouble and communication cut off.

Norfolk, Va.: a northerly gale prevailed throughout the day of the 31st, attaining a maximum velocity of forty miles per hour from the northeast. The gale is said to have been of longer duration and caused more damage than any storm since the memorable August gale in 1879. A number of vessels were blown ashore and became total wrecks. The captain and one man of the schooner "Manantico" were drowned. On account of heavy rains and high tides, much merchandise has been damaged or destroyed by water.

XI.—A slight depression was observed in the western Saskatchewan valley on the afternoon of the 29th. Although the barometer was but little below the normal, yet the pressure had decreased nearly .3 in that vicinity during the previous eight hours, and a high area, about .6 above the normal, then existed west of Lake Superior. This low area advanced southeastward through the valley, reached the lakes north of Manitoba on the afternoon of the 30th, and thence passed eastward into the British Possessions beyond the field of observation. The high pressure which had meanwhile moved southward probably modified its path and forced it farther to the northward. A low area was observed near the mouth of the Saint Lawrence on the afternoon of the 31st and still remained in that vicinity at the close of the month. This is believed to have been the same depression which was last observed near Lake Winnipeg on the 30th, and which had apparently progressed thus far seaward.

NORTH ATLANTIC STORMS.

[Pressure in inches and millimetres; wind-force by Beaufort scale.]

MOVEMENTS OF HIGH BAROMETER AREAS OVER THE NORTH ATLANTIC OCEAN.

In the preparation of the following discussion, by Sergeant E. B. Garriott, Signal Corps, daily charts for 1885, containing data from international simultaneous observations taken at noon, Greenwich mean time, have been carefully studied, with a view of determining the general movement of anti-cyclones over the north Atlantic:

The scientific methods pursued by the Signal Service during the past few years in the study of marine meteorology have resulted in deducing facts relative to the movements of ocean storms, whose practical value can hardly be overestimated. These deductions, while to a considerable degree verifying the results of old observations taken and collected by individuals, have, by their wider scope, and in view of the increased facilities afforded by a systematic series of simultaneous meteorological observations taken by hundreds of shipmasters, permitted a more accurate definition of the general laws which attend atmospheric changes over the north Atlantic Ocean. In connection with the current work of the Signal Office, the cyclonic depressions which appeared over the north Atlantic Ocean have been traced and described, and their general characteristics as regards direction and velocity of movement, frequency, and distribution, have been fairly well determined. This work has been necessarily performed in a very limited time, and is, therefore, lacking in details as to the causes which seemed to contribute to the normal and abnormal movements of cyclones. Further labor and judgment will therefore be needed to extract from the invaluable accumulation of data on file the facts that will lead up to a clearer understanding of the laws governing storm movements on the north Atlantic.

In an article entitled "North Atlantic storms during 1885," which appeared

in the MONTHLY WEATHER REVIEW for July, 1887, the apparent dependence of a cyclone's movement upon its position with reference to anti-cyclonic areas was briefly discussed, and it was shown by a tabulated statement that during periods of high barometric pressure over mid-ocean north of the fortieth parallel, storm-areas do not follow the usual east-northeast course to European waters, but pursue a more northerly track, or disperse.

As areas of high barometric pressure influence to a greater or less degree the movements of low barometer areas, and as the anti-cyclonic and cyclonic areas are chiefly and conjointly instrumental in producing all atmospheric changes, it would seem that investigations tending to produce facts relative to the movements of anti-cyclones over the Atlantic would be of interest when considered in connection with the movements of cyclonic areas, and of value in determining the laws and conditions which govern weather changes in the great highways of the ocean.

The series of international observations show that an accumulation of air exhibiting an anti-cyclonic circulation is commonly located over mid-ocean south of the fortieth parallel, and that a barometric depression usually occupies the ocean north of the fiftieth parallel. The storm-track charts also show that the normal direction of movement of cyclonic areas in any given locality corresponds closely with the prevailing wind-directions in that locality, which are governed over the ocean by the anti-cyclonic and cyclonic systems referred to. It has been found that in their passage from the North American continent areas of high and low barometric pressure follow one another with a great degree of regularity, and that while areas of low pressure have a normal north of east course after leaving the coast, the high pressure areas almost invariably move south of east. The normal direction of movement of cyclonic areas in the trans-Atlantic tracks is evidently due to the prevailing drift of the atmosphere in the vicinity of the fiftieth parallel, along the line of which is the intermediate region between what may be termed the permanent areas of high and low mean barometric pressure, under the combined influence of which the

prevailing winds in that latitude are from about west-southwest. The almost constant presence of these extensive anti-cyclonic and cyclonic areas in the region named is attributed to influences exerted by the more general laws and movements of the atmosphere over the earth's surface, and is also ascribed, in part, to the deflection of the normal air currents by the more elevated portions of the continents. Suffice it to say in treating of the meteorology of the north Atlantic Ocean, that upon advancing from the American coast areas of low barometer appear to move towards the region of barometric minima, and areas of high pressure are apparently attracted to the region of maxima.

During 1885 sixty areas of low pressure advanced eastward over the ocean from the American coast; during the same period fifty-two well-defined areas of high barometer were traced from the interior of the continent and passed off the coast, of which seven traversed the ocean to Europe, and three moved northeast to the vicinity of Iceland; the remaining high areas advanced east or south of east and united with the cyclonic system south of the fortieth parallel. In tracing the anti-cyclonic areas eastward from the Mississippi Valley to the coast, it was shown that between the thirtieth and fortieth parallels the paths ran almost due east, while to the northward of the fortieth parallel they were south of east, the southern inclination increasing with the northern origin of the areas. The great uniformity of movement of the areas of high pressure, about 90 per cent. of which pursued a south of east course from the American coast, seems to indicate that their direction of movement can be calculated with a greater degree of certainty than the probable track of low pressure areas. It would also appear from a study of the simultaneous movements of high and low barometer areas over the ocean that the areas of high pressure move with greater rapidity than low areas, and that the direction of their course and the velocity of their movement is seldom influenced by the cyclonic areas which may precede or follow them. On the other hand it has been observed that the movements of cyclonic areas are largely influenced by anti-cyclonic areas, which apparently cause barometric depressions to deviate from their course, and in many instances to dissipate, when situated in their line of advance. Without considering the anti-cyclonic areas of an apparent local character which appeared during the year over the land and ocean, but confining the discussion to the more important and well-defined high areas which traversed the continent east of the Mississippi Valley and advanced over the ocean, it is shown that the high and low areas traced from the American coast during 1885 corresponded closely in number, and a careful tracing of the high areas from the ninetieth meridian shows few instances wherein they deviated from the normal south of east track over the western Atlantic.

On account of the numerous combinations in the relative positions of high and low barometric areas which they present upon leaving the coast, it is not possible with our present knowledge of ocean meteorology to formulate an infallible rule for determining their movements. A set of rules could, however, be deduced from an exhaustive study of individual high and low areas, whereby cyclones of a given intensity and pursuing similar paths could be classified, and their relation to, and dependence upon, anti-cyclones determined. By this means the position, strength, and progressive velocity of cyclones, as well as their proximity or relation to anti-cyclones would permit of their classification with storms which had presented similar characteristics, and whose course subsequent to leaving the coast had been determined. This classification would seem the more necessary in the case of cyclonic areas on account of the more frequent irregularities noted in their movements, which are apparently occasioned in a great majority of instances by the presence or movements of anti-cyclonic areas. A general rule, based upon the movements of anti-cyclonic areas during 1885, may be given, which would doubtless be applicable to a large proportion of the storm-areas which advance over the continent and the ocean. The average time occupied by the fifty-two anti-cyclones traced in advancing from the ninetieth meridian to the coast was about one and one-half days, this rate of progression being considerably greater than the average velocity of cyclonic areas over that region.

Lines representing the mean paths of the anti-cyclones would converge over the ocean to a point in about N. 35°, W. 35°. Assuming that, by their greater density or weight, and on account of the known regularity of their movements, anti-cyclones largely control the movements of cyclonic areas, it would appear that the probable course and rate of progression of a cyclonic area could be fairly well determined upon its passage from the continent by considering its position relative to well-defined high barometer areas which precede or follow it. Upon advancing to the vicinity of the sixtieth meridian high barometer areas, as a rule, lose their individuality and become a part of the great anti-cyclonic system which commonly occupies mid-ocean south of the fortieth parallel, visibly extending westward to the vicinity of the American coast with the absorption of areas of high barometer, and, subsequent to the union, gradually contracting its western limit. It therefore appears that in the case of cyclones which closely follow the passage of high barometer areas from the coast, it is reasonable to anticipate an abnormal northerly course, and that the greater the period which exists between the advance of the areas from the coast line the greater would be the likelihood of the low pressure area pursuing a normal path over the ocean. This supposition is the more warranted when the fact is taken into consideration that in the normal movement of cyclonic and anti-cyclonic areas, the latter more frequently closely follow and accelerate the forward motion of the former upon passing from the coast, and materially contribute to the greater rapidity of their advance over the ocean.

As regards the changes in position of the anti-cyclonic area over mid-ocean and the occasional shifting to the westward of high barometer areas from over northern Europe, whereby the barometric pressure over the ocean in high latitudes is greatly increased, it would not be possible in the absence of telegraphic reports from east of the thirtieth meridian to determine the barometric conditions

which would exist over the eastern portion of the ocean in advance of a cyclonic depression leaving the American coast. A knowledge of the normal movements of anti-cyclonic areas over the continent and the western portion of the ocean, which is so clearly shown by tracings made of their paths during 1885, and a fair understanding of the relations which exist between high and low barometer areas attending their passage from the coast, would suffice to determine with a considerable degree of accuracy the probable influence of a cyclone's action along a greater part of the trans-Atlantic ship routes. For a more comprehensive knowledge of the more complicated relations which exist between high and low barometer areas attending the abnormal movement of cyclones, it will be necessary to classify for study the anti-cyclonic and cyclonic areas which advance eastward from the American continent, and, following such a classification, it would be possible to recognize the normal and abnormal features peculiar to the storms of the north Atlantic Ocean prior to their departure from the coast, and to determine their probable path.

The paths of the depressions that have appeared over the north Atlantic Ocean and in the vicinity of the West India Islands during the month of October, 1887, are determined, approximately, from international simultaneous observations furnished by captains of ocean steamships and sailing vessels; reports received through the co-operation of the Hydrographic Office, U. S. Navy, and the "New York Herald Weather Service;" and from other miscellaneous data received at this office up to November 21, 1887.

Sixteen depressions are traced, of which, eight were of tropical or subtropical origin; four advanced eastward over Newfoundland, one of which traversed the ocean from coast to coast; three moved northeastward from the middle Atlantic coast of the United States; one is first charted over the ocean northeast of Newfoundland, and one is located on the last day of the month to the westward of the British Isles.

In the vicinity of the American coast south of the fortieth parallel, the month was characterized by a succession of storms of moderate energy, which advanced northeast towards Newfoundland; while to the northward of the forty-fifth parallel, each decade embraced storms of pronounced strength. To the northward and northeastward of the Windward Islands, and over the west portion of the Caribbean Sea, and in the Gulf of Mexico, there is an unusual prevalence of charted cyclonic depressions, which fact may, perhaps, be attributed to an increase in the number of reports received from those regions, whereby the location and tracks of storms could be the better determined. Over mid-ocean, along the trans-Atlantic tracks, storms were less frequent than during corresponding months of previous years and the depressions traced possessed but normal energy. In the vicinity of the Azores unsettled and stormy weather, with low and fluctuating barometric pressure, prevailed during a greater portion of the first and second decades of the month. In European waters the weather conditions continued settled, and high barometric pressure prevailed, except at the close of the first, and beginning of the second, decades, and subsequent to the 26th, when the approach and passage of barometric depressions occasioned disturbances, the severity of which were more marked during the last five days of the month.

In October, 1886, fourteen depressions were traced, of which one traversed the ocean. The storms developed greatest intensity off the west coast of Europe, between the forty-fifth and sixtieth parallels, the second decade being especially marked by storms of exceptional violence in that region; over the western portion of the ocean and along the American coast, no storms of pronounced strength appeared after the second day of the month. The tropical cyclone which entered the Gulf of Mexico at the close of the first decade was very severe and destructive in its character.

In October, 1887, the severest weather was experienced in the vicinity of the British Isles during the last five days of the month; over mid-ocean, in high latitudes, there was a marked deficiency in the aggregate number of depressions which appeared, when compared with those traced for corresponding months of previous years; while in middle and southern latitudes the number of storms charted exceed the normal for the month, although reports do not indicate a degree of energy on

the part of the West India cyclones commensurate with that which commonly characterizes the storms of that region.

The following are descriptions of the depressions traced:

1.—The development or presence of a cyclonic area was indicated to the northeastward of Newfoundland on the 1st, and vessel reports of the 2d admitted of locating its centre in about N. 51°, W. 45°. On this date high barometric pressure over the ocean north of the fiftieth parallel and east of the thirtieth meridian apparently retarded the eastward advance of the depression. On the morning of the 4th the area of high barometer had moved to the eastward of the twentieth meridian, and in the interval the storm-centre recurved to the northwestward. During the 4th and 5th the depression moved slowly south of east along the southwest margin of the high pressure area, and on the 6th again recurved to the northward. The continued presence of the area of relatively high barometer to the northeastward, however, apparently checked the storm's inclination to assume a normal advance movement, and forced it southward to the vicinity of the Azores by the 8th, whence it moved north of east, passing over the Bay of Biscay during the 9th, on which date the pressure was high north of the fiftieth parallel between W. 20° and 30°. By the 10th the depression had advanced over the continent of Europe beyond the region of observation. This depression displayed considerable energy during the 1st, 2d, and 3d, after which little strength was shown. The following reports refer to disturbances which attended its passage previous to the 4th:

Captain Jüngst, of the s. s. "Ems," reports a whole gale on the 2d and 3d; wind veered from s. to n.; lowest barometer, 29.34 (745.2), at 4 p. m. of the 2d, in N. 48° 44', W. 36° 36'. The s. s. "Milanese" encountered a strong gale on the 1st and 2d; wind veered from sse. to ssw.; lowest barometer, 29.53 (750.0), at noon of the 2d, in N. 46° 58', W. 29° 46'. Capt. R. T. Jones, of the s. s. "Galileo," reports a fresh gale on the 3d; wind veered from sse. to nw.; lowest barometer, 29.53 (750.0), at 4 a. m., in N. 47° 58', W. 39° 42'.

2.—This storm apparently originated off the coast of the United States south of the fortieth parallel during the 4th; on the 5th the depression was central in about N. 38°, W. 69°, whence it moved northeast to the southeast extremity of Newfoundland by the 7th; by the 8th the storm-centre had recurved northwestward and united with a cyclonic area which had advanced eastward over the Gulf of Saint Lawrence. This depression was unattended by noteworthy features.

3.—This depression is traced from the Caribbean Sea westward along the twentieth parallel over Yucatan and the southern portion of the Gulf of Mexico during the 6th, 7th, and 8th, its path being determined, approximately, by a limited number of vessel reports. While the cyclonic nature of this storm is well defined by charted reports, its course was too far to the southward to accurately determine its strength.

4.—The presence of this depression over the Caribbean Sea was shown by reports of the 8th; by the 9th the storm-centre had apparently moved westward to about N. 19°, W. 71°, and on the morning of the 10th it had moved northwest over the western extremity of Cuba, whence it passed slowly westward over the Gulf of Mexico. The path of this storm subsequent to the 11th cannot be determined, owing to an absence of reports from the region east of the position it occupied on that date. The following reports show the general character of the disturbances which attended its passage:

"Havana, 10th, barometer 29.89 (759.2); wind se., eleven miles; cloudy weather; $\frac{1}{8}$ cirro-stratus clouds moving from the sw.; storm-centre west of station." Captain McKay, of the s. s. "Alvena," reports: "8th between Cape Maysi, Cuba, and Castle Island, at 4.57 a. m., Greenwich mean time; at 8.12 a. m., barometer 29.63 (752.6), and falling rapidly; 9.27 a. m., barometer lowest, 29.36 (745.7), after which it commenced to rise. The weather during this time was heavy and threatening, with wild-looking clouds from n. to s. and around to w.; at the last-mentioned hour the clouds parted in east to north and the greater portion remained in the south, but no rain fell.

9th, between N. 25° 10', W. 74° 8' and N. 28° 00', W. 74° 15'; at 4.50 a. m., Greenwich time, a fresh gale commenced, with heavy rain and a rough sea from e.; gale continued till 7 p. m., when it moderated; lowest barometer, 29.59 (751.6), 9 a. m."

5.—This depression passed eastward over northern Newfoundland and on the morning of the 9th was central in about N. 50°, W. 54°. During this and the following seven days the storm moved slowly east-southeast, passing over the Azores on the 14th, and disappearing over the ocean to the eastward of that group after the 16th. The abnormal direction of movement assumed by this storm was apparently due to the prevalence over mid-ocean, north of the fiftieth parallel, of an area of high barometric pressure, along the southeast and southern margins of which the depression slowly shaped its path. The character of this storm is shown by the following reports:

Capt. G. Moody, of the s. s. "State of Georgia," reports a fresh gale on the 9th; wind from sw. to nw.; lowest barometer, 29.39 (746.5), at 8 a. m., in N. 44° 46', W. 57° 27'. Captain Trinick, of the s. s. "Milanese," reports a fresh nw. gale on the 9th; lowest barometer, 29.43 (747.5), at noon, in N. 43° 06', W. 57° 46'. Capt. J. Jameson, of the s. s. "India," reports a strong gale from the 8th to the 11th; wind veered from nnw. to nne.; lowest barometer, 29.31 (744.5), at 11.40 p. m. of the 10th, in N. 45° 40', W. 54° 35'.

Third Officer J. H. Mills, of the s. s. "Aurania," Capt. W. H. P. Hains, commanding, reports a whole gale on the 11th and 12th; wind veered from se. to sw.; lowest barometer, 29.19 (741.4), at noon of the 12th, in N. 48° 12', W. 38° 40'. Capt. W. J. Boggs, of the s. s. "Indiana," reports a fresh gale on the 11th and 12th; wind veered from ssw. to nw.; lowest barometer, 29.27 (743.4), at 2 p. m. of the 11th, in N. 45° 32', W. 46° 00'. Captain Milburn, of the s. s. "Ocean Prince," reports a storm on the 11th and 12th; wind backed from se. to e., ne., and nnw., blowing hardest from nnw.; lowest barometer, 28.92 (734.6), at 7.30 p. m., Greenwich time, in N. 38° 07', W. 41° 55'.

6.—The presence of this depression northeast of the Windward Islands was shown on the morning of the 9th; by the 11th the storm had moved northeast to N. 30°, W. 40°, from which position it passed northward and united with depression number 5, which had advanced southeast from Newfoundland.

The following extracts from ships' logs have been furnished by Rev. Benito Viñes, S. J., director, Belen Meteorological Observatory, Havana, Cuba:

"The Spanish s. s. 'Navarro,' October 10th, at night, fine weather, steady west wind, light clouds, moving swiftly from s., growing heavier, and wind changing to the third quadrant; 11th, in N. 34° 0', W. 40° 20', at noon; during the early morning the barometer fell rapidly, with wind se. and ese., and violent gusts and high sea from sw., and heavy rain. At 7 a. m. the wind was furious from ene., with heavy rain and enormous seas from the second and third quadrants; 8.30 a. m., wind ne., blowing with terrible fury; sea confused from third, second, and first quadrants, being more pronounced from sw.; 9.30 a. m., wind nne., with terrific squalls; intervals of calm, and barometer oscillating from 28 to 29 inches; 11.30 a. m., wind nw.; barometer rising rapidly. The s. s. 'Ardanach,' October 11th, at noon, in N. 37° 20', W. 38° 23', strong sw. gale and a very heavy sea; barometer 29.49 (749.0) and very unsteady; 4 p. m., wind increasing to about force 10; low stratus and nimbus clouds, moving very rapidly from wsw.; barometer falling; 6 p. m., wind suddenly shifted to w., and blew with hurricane force, causing a fearful sea; continued blowing at about force 12 for four hours, and at 10 p. m. commenced to moderate. During the storm the lowest barometer reading was 29.20 (741.7) and not so unsteady as at noon; the clouds were very low stratus and were travelling very rapidly from the w. The storm seemed to occupy a small area, as previous observations showed fine weather, and the same prevailed shortly after the storm's passage."

7.—This storm is first charted over the Caribbean Sea south of Jamaica under date of the 11th, whence it moved slowly west-northwest to the Texas coast by the 18th, after which it

recurred northeastward. The following reports indicate the character of the disturbances which attended its passage:

"The corvette 'Nalon,' from Belize to Cienfuegos; 10th, in N. 19° 50', W. 75° 20', heavy sea from ese.; in southeast quadrant heavy clouds, which caused violent gusts of wind and rain; wind oscillated from ese. to se. and barometer fell slowly. 11th, in a. m., wind hard from ese., heavy clouds and violent gusts of rain and wind; in p. m. barometer fell considerably, to 29.33 (705.0) at 6 p. m., weather dark, and rain continuous; 8 p. m., terrible rolling sea from ese. to ssw.; during the night continuous rain and violent gusts; barometer fell to 29.21 (742.0). 12th, in a. m., rain continued, with hurricane from se. to s., the sea a boiling mass, and so it continued to the end of the day's run, in N. 20° 45', W. 77° 0', with barometer steady at 29.21 (742.0); in afternoon much rain and wind, sea more moderate; 6 p. m., weather cleared somewhat, and barometer rose slightly; during night violent gusts from s. and ssw. 12th, noon, in N. 20° 50', W. 76° 30', barometer rising slowly to 29.29 (744.0), hard gusts. 13th, hard sw. gusts at long intervals; sea from ese., and diminishing; barometer rising."

Havana, 12th, 9 a. m., barometer 29.74 (755.4), e., light rain, 10 miles, storm-centre sse. of station; 3 p. m., barometer 29.64 (752.8), e., heavy rain, 20 miles, storm-centre south of station. Havana, 13th, barometer 29.69 (754.1), e., light rain, 25 miles. Cienfuegos, 12th, 3 p. m., barometer 29.70 (754.4), se., heavy rain, violent gusts. Havana, 14th, 6 a. m., barometer 29.70 (754.4), se., cloudy, 19 miles, storm-centre sw. of station, moving west. Trinidad, Santa Cruz, violent gusts from se., light rain; seaswell sse. Capt. James Bolger, of the s. s. "Neuces," reports a strong gale from the 13th to the 15th; wind veered from nne. to ene.; lowest barometer, 29.73 (755.1), at 12 noon of the 14th, in N. 24° 50', W. 85° 3'. After the gale the wind continued to blow from ese., accompanied by heavy rain squalls to Key West. Capt. P. H. Hanlon, of the s. s. "Mascotte," reports a whole gale on the 14th and 15th; wind veered from ne. to se.; lowest barometer, 29.68 (753.9), at 1 a. m. of the 15th, in N. 25° 30', W. 82° 20'. Captain Jørgensen, of the bark "Adele Sabina," reports a storm on the 19th and 20th; wind veered from ese. to wnw.; lowest barometer, 29.35 (745.5), at 1 p. m. of the 19th, in N. 30° 08', W. 87° 10'. Capt. John Stewart, of the bark "Gettysburg," reports a storm on the 19th; wind veered from se. to w.; lowest barometer, 29.38 (746.2), at 11 a. m., in N. 29° 55', W. 87° 10'.

8.—This depression first appeared east of Bermuda on the 12th, whence it had apparently advanced from eastward of the Windward Islands; by the 13th the storm-centre had moved rapidly north-northeast and united with depression number 9 on the northeast edge of the Banks of Newfoundland, without evidence of marked energy.

9.—This storm passed southeast from the northern extremity of Newfoundland and united with number 9, as above stated; subsequent to the morning of the 13th the depression advanced rapidly east-southeast and united with number 5 in the vicinity of the Azores, without a special display of strength.

10.—This depression was central on the 14th in about N. 35°, W. 69°, whence it had advanced from the southwestward; by the 15th the storm-centre had moved rapidly northeast to the east coast of Newfoundland, and thence passed to N. 52°, W. 39°, after which it disappeared in the direction of Iceland beyond the region of observation. This storm possessed moderate strength, and was accompanied by fresh to strong gales during the 15th and 16th.

11.—This storm apparently originated in the tropics, east of the fiftieth meridian, and by the 16th it was central in about N. 17°, W. 52°, whence it moved slowly northwest to the twenty-fifth parallel by the 18th. During the next twenty-four hours the centre of depression recurred northeastward to the thirtieth parallel, after which it passed northward and probably united with depression number 12. No special reports have been received relative to this storm, and a scarcity of simultaneous observations from the region through which it passed renders it impossible to determine its strength.

12.—This depression appeared off the coast of the United States, in the vicinity of the thirty-fifth parallel, on the morning of the 19th, whence it passed northeast to the fortieth parallel in about W. 65°, and thence advanced eastward to the sixtieth meridian by the morning of the 20th. During this and the following date the depression moved slowly southeast and disappeared after the 21st. The abnormal direction of movement assumed during the last two days of its course was apparently occasioned by an area of relatively high pressure which occupied the ocean to the northeastward of its position. The storm displayed small energy, and, aside from its abnormal course, was unattended by noteworthy features.

13.—The presence of this depression over the ocean between N. 20° and 25° and W. 45° and 50° was shown by vessel reports of the 22d and 23d, which were not, however, sufficiently numerous in that region to determine its strength or to admit of charting its track previous or subsequent to those dates.

14.—This was the most important depression which appeared during the month, and in its passage from Newfoundland to the British Isles, from the 23d to the 29th, inclusive, augmented energy day by day and occasioned storms of hurricane force over, and to the westward of, the British Isles during the last five days of the month. The depression pursued an almost normal track to the northward of the trans-Atlantic steamer routes, its advance being checked on the 25th by an area of high barometer to the eastward. The giving way to the south-eastward of this area of high pressure was followed during the 26th by an advance on the part of the cyclonic area, which moved slowly eastward to the north of Ireland by the 29th, where it apparently remained almost stationary until the 30th, during which date it probably passed into the North Sea, where its presence was indicated by reports of the 31st.

The following special reports show the character of the disturbances encountered in the southern quadrants of this cyclone during its passage over the Atlantic, previous to which heavy gales were experienced off the coast of the United States, attending the passage of land low area number vi, of which it was a continuation:

Mr. J. Higgins, observer at Saint John's, Newfoundland, reports that on the night of the 24th the wind veered suddenly from northwest to south, and increased to a gale, with heavy rain showers, which continued till 5 a. m. of the 25th. Capt. M. de Jouselin, of the s. s. "La Bretagne," reports a fresh gale on the 26th and 27th; wind veered from wsw. to wnw.; lowest barometer, 29.83 (732.3), at 8 a. m. of the 26th, in N. 49° 20', W. 40° 10'. Capt. H. McKay, of the s. s. "Servia," reports a whole gale on the 26th and 27th; wind veered from wsw. to nw.; lowest barometer, 29.76 (755.9), at 6 a. m. of the 26th, in N. 49° 54', W. 34° 48'. Captain Heeley, of the s. s. "England," reports a strong gale from the 26th to the 28th; wind veered from sw. to nw.; lowest barometer, 29.82 (757.4), at 4 a. m. of the 26th, in N. 49° 43', W. 39° 09'. Capt. Rud Weyer, of the s. s. "Pennland," reports a whole gale from the 25th to 29th; wind veered from se. to nw.; lowest barometer, 29.82 (757.4), at 6 p. m. of the 26th, in N. 50° 00', W. 29° 00'.

Second Officer F. Potts, of the s. s. "British Crown," Capt. A. Smith, commanding, reports a strong s. to wnw. gale on the 25th and 26th; lowest barometer, 29.80 (756.9), at 8 a. m. of the 26th, in N. 50° 38', W. 19° 10'. The s. s. "British Crown" encountered a strong west gale from the 27th to the 29th; lowest barometer, 29.77 (756.1), at midnight of the 28th, in N. 50° 05', W. 32° 50'. Capt. H. C. v. d. Zee, of the s. s. "Edam," reports a whole gale from the 27th to the 29th; wind veered from w. to nw.; lowest barometer, 29.75 (755.6), at 11 p. m. of the 28th, in N. 49° 42', W. 30° 52'. Captain Jeffrey, of the s. s. "Greece," reports a whole gale on the 29th and 30th; wind veered from se. to sw.; lowest barometer, 28.76 (730.5), at 0.45 a. m. of the 30th, in N. 49° 47', W. 4° 49'. Captain Franck, of the s. s. "Australia," reports a whole gale on the 29th and 30th; wind veered from s. to nw.; lowest barometer, 28.75 (730.2), at 11 p. m. of the 29th, when off Portland.

15.—This depression was central on the 30th in N. 31°, W. 74°,

whence it had apparently advanced from the southward; by the 31st it had moved east of north to the thirty-fourth parallel, accompanied by strong to whole gales. The following special reports refer to this storm: Captain Evans, of the s. s. "Claribel," reports a whole gale with squalls of hurricane force from October 30th to November 1st; wind veered from nne. to se. and backed again to nne.; lowest barometer, 29.35 (745.5), at 4 p. m. of the 31st, in N. 37° 00', W. 74° 00'. Captain Schive, of the brig "Lilian," reports: "30th, blowing heavy from ne. and ene., with heavy rain and lightning; 31st, wind lulled and hauled to se. and s., blowing hardest from ssw.; lowest barometer, 29.44 (747.8), from sundown to midnight of the 31st, in N. 35° 30', W. 74° 30'. Capt. A. Leenhard, of the bkt. "Jose E. More," reports a whole gale from October 30th to November 2d; wind veered from ne. to sw. and nw.; lowest barometer, 29.39 (746.5), at 4 p. m. of the 31st, in N. 35° 26', W. 75° 10'. Capt. J. H. Bennett, of the s. s. "Edith Godden," reports a whole gale on the 30th and 31st; wind veered from ne. to e. and to s. by w.; lowest barometer, 29.32 (744.7), at noon of the 31st, in N. 35° 54', W. 73° 10'.

16.—This depression, which appeared suddenly on [the 31st, in N. 56°, W. 21°, with central pressure ranging to about 28.60 (726.4), is thought to have been a subsidiary development to depression number 14, although there is a reasonable likelihood that the last-named storm may have made a recurve westward from its position to the northward of Ireland on the 30th. In an absence of reports from western Europe and from the region north of the fifty-fifth parallel it is not possible at present to determine the movements of this storm subsequent to the 30th. It is hoped, however, that reports received before the next issue of this publication will permit of accurately defining the relations which existed between these depressions.

OCEAN ICE.

On chart i are also shown the positions in which icebergs were reported during October, 1887. These positions are determined from reports furnished by shipmasters, and from data collected by the Hydrographic Office.

Ice was reported on three dates only, viz., on the 17th one very large berg was observed in N. 42° 58', W. 50° 02', from the s. s. "Bassano;" on the 29th two large bergs and several small pieces of ice were passed in N. 52° 05', W. 54° 00', by the s. s. "Grecian," and on the 31st the captain of the s. s. "Toronto" observed two large bergs, one in N. 51° 50', W. 54° 23', and the other in N. 52° 06', W. 54° 08'.

In October, 1886, the southernmost ice reported was over one degree farther south and in about the same longitude, while the easternmost position in which ice was observed was about four degrees farther east than in the corresponding month of 1887; the aggregate quantity greatly exceeded that reported for the present month.

As compared with ice reported for the four preceding years a marked deficiency in quantity is shown for October, 1887. The southernmost position in which ice was observed is about three degrees south of the normal southern limit for the month, while the easternmost ice reported was about two degrees west of the average eastern limit.

The following table shows the southern and eastern limits of the region within which ice was reported for October during the last five years:

| Southern limit. | | | Eastern limit. | | |
|--------------------|---------|----------|--------------------|---------|----------|
| Month. | Lat. N. | Long. W. | Month. | Lat. N. | Long. W. |
| October, 1883..... | 46 56 | 46 22 | October, 1883..... | 46 56 | 46 22 |
| October, 1884..... | 46 56 | 46 22 | October, 1884..... | 46 56 | 50 55 |
| October, 1885..... | 48 21 | 47 12 | October, 1885..... | 48 21 | 47 12 |
| October, 1886..... | 41 34 | 49 43 | October, 1886..... | 46 03 | 46 37 |
| October, 1887..... | 42 58 | 50 02 | October, 1887..... | 42 58 | 50 02 |

* Near Cape Race.

FOG.

The following are the limits of fog-areas on the north Atlantic Ocean during October, 1887, as reported by shipmasters:

| Date. | Vessel. | Entered. | | | Cleared. | | |
|-------|----------------------------|----------|---------|---------------|----------|---------|----------------|
| | | Lat. N. | Lon. W. | Time. | Lat. N. | Lon. W. | Time. |
| 3 | S. S. City of Richmond... | 41 23 | 66 59 | ..... | 42 45 | 62 09 | ..... |
| 5 | S. S. Richmond Hill..... | 45 56 | 56 30 | ..... | 43 58 | 61 00 | ..... |
| 5-6 | S. S. LaBourgnie..... | 48 00 | 47 00 | ..... | 47 30 | 57 18 | ..... |
| 6 | S. S. City of Richmond... | 46 48 | 47 39 | ..... | 47 03 | 46 38 | ..... |
| 6-7 | Fog at Saint John's, N. F. | | | | | | |
| 7 | S. S. Galileo..... | 42 04 | 47 35 | ..... | 41 44 | 49 05 | ..... |
| 7 | S. S. Elder..... | 46 39 | 47 00 | ..... | 45 49 | 49 55 | ..... |
| 7 | Fog at Saint John's, N. F. | | | | | | |
| 9 | S. S. Geiser..... | 48 55 | 48 20 | ..... | 47 58 | 49 56 | ..... |
| 9 | Fog at Saint John's, N. F. | | | | | | |
| 10 | Fog at Saint John's, N. F. | | | | | | |
| 11 | Fog at Saint John's, N. F. | | | | | | |
| 11 | S. S. India..... | 46 16 | 54 08 | ..... | 46 25 | 53 25 | ..... |
| 12 | Fog at Saint John's, N. F. | | | | | | |
| 12 | S. S. Circassia..... | 47 13 | 50 50 | 6 a. m.... | 47 40 | 49 30 | 6 p. m.... |
| 12 | S. S. India..... | 47 11 | 43 42 | ..... | 47 01 | 44 28 | ..... |
| 12 | S. S. LaChapagne..... | 46 55 | 44 56 | ..... | 46 48 | 45 32 | ..... |
| 12-13 | S. S. Vaderland..... | 46 45 | 48 30 | ..... | 48 03 | 43 48 | At inter-vals. |
| 12 | Fog at Saint John's, N. F. | | | | | | |
| 13 | Fog at Saint John's, N. F. | | | | | | |
| 15 | S. S. Ems..... | 45 45 | 48 25 | ..... |  |  |  |
| 20 | Fog at Saint John's, N. F. | | | | | | |
| 21 | S. S. Westernland..... | 47 14 | 43 32 | ..... | 45 50 | 48 31 | ..... |
| 21 | S. S. Main..... | 43 10 | 57 24 | ..... | 43 30 | 57 51 | ..... |
| 21 | S. S. Surrey..... | 43 18 | 52 00 | ..... | 43 46 | 48 30 | ..... |
| 21 | Fog at Saint John's, N. F. | | | | | | |
| 22 | Fog at Saint John's, N. F. | | | | | | |
| 22 | S. S. Westernland..... | 44 26 | 52 46 | ..... | 44 22 | 53 04 | ..... |
| 22 | S. S. Canada..... | 46 50 | 44 26 | ..... | 45 47 | 48 46 | ..... |
| 27 | S. S. Alamo..... | 36 38 | 74 50 | 5-40 p. m.... | 36 10 | 75 00 | 7-30 p. m.... |
| 28 | S. S. City of Washington. | 37 58 | 74 59 | 10 a. m.... | 36 51 | 74 56 | 4 p. m.... |
| 29 | S. S. LaBretagne..... | 41 50 | 66 00 | 9-30 a. m.... | 41 40 | 66 20 | 10-30 a. m.... |
| 29-30 | S. S. Servia..... | 42 17 | 62 32 | 11 p. m.... | 42 02 | 63 36 | 2 a. m.... |
| 31 | S. S. British Crown..... | 48 00 | 49 00 | 8 p. m.... | 47 30 | 49 45 | 11 p. m.... |
| 30-31 | S. S. Cephalonia..... | 43 42 | 51 58 | ..... | 44 32 | 48 34 | ..... |

On chart i the limits of fog-belts to the westward of the fortieth meridian are shown by dotted shading:

As compared with the chart for September, 1887, the southern limit of fog reported in the vicinity of the Banks of Newfoundland during October is shown to be about one-half degree farther south, while the eastern limit is contracted about five degrees. To the southward of Nova Scotia the southern limit remains about the same; in the immediate vicinity of the coast of the United States no fog was reported north of the thirty-eighth parallel, whereas in the preceding month several fog-belts of limited area appeared between N. 37° and 43°.

As indicated by special reports received, fog was less frequently encountered in the vicinity of the Banks of Newfoundland than in September, or during the summer months, while to the westward of the sixtieth meridian the dates covered by reports correspond with the number for which fog was observed in September.

The following shows the general meteorological conditions which attended the development of a fog over and near the Banks of Newfoundland:

From the 5th to the 7th, inclusive, depression number 2 occasioned south to east winds over the Banks, and reports show that dense fog prevailed during this period. During the 9th, 10th, and 11th, the advance of depression number 5 over Newfoundland, and its subsequent presence over the Banks, was accompanied by winds from the southeast quadrant and fog. On the 12th and 13th depression number 8 moved rapidly northeast from the vicinity of Bermuda, passing over the Banks during the 13th; its approach and passage being attended by fog. The fog of the 15th was evidently due to the influence of depression number 10, which moved northeast over Newfoundland during that date. From the 20th to the 22d, inclusive, south to east winds and fog prevailed with the presence to the westward and southwestward of depressions numbers 12 and 14, the latter being a continuation of an area of low pressure of pronounced energy which advanced north-east along the Atlantic coast. During the 30th and 31st south to east winds and fog were reported over the Banks, these conditions being apparently caused by an area of low pressure

which passed eastward north of the region of observation, the presence of which was indicated not only by the wind-direction, but also by the low barometric pressure recorded over and near Newfoundland on those dates. On the dates not included in the above-named periods no fog was reported.

Over the ocean south of Nova Scotia fog was reported on the 3d, 29th, and 30th. On the 3d north to west winds and baro-

metric pressure below the normal attended the presence over New Brunswick of an area of low pressure. During the 29th and 30th depression number 15 caused easterly winds and falling barometer in that locality.

Fog was reported off the coasts of Virginia and Maryland on the 27th and 28th, during the prevalence of which high barometer, north to east winds, and rain prevailed.

TEMPERATURE OF THE AIR (expressed in degrees, Fahrenheit).

The distribution of mean temperature over the United States and Canada for October, 1887, is exhibited on chart ii by the dotted isothermal lines. In the table of miscellaneous data are given the monthly mean temperatures, with the departures from the normal, for the various stations of the Signal Service. The figures opposite the names of the geographical districts in the columns for mean temperature, precipitation, and departures from the normal, show respectively the averages for the several districts. The normal for any district may be found by adding the departure to the current mean for the district when the departure is below the normal, and subtracting when above. On chart iii the departures from the normal are illustrated by lines connecting stations of normal or equal abnormal values.

The mean temperature is decidedly above the normal in Oregon, California, and the plateau districts, and slightly above the normal in eastern Nova Scotia. The excess over the normal temperature is greatest in northern California, where, at Red Bluff, an unusual departure of 10° occurs. On chart iii the line indicating the region over which the temperature was 4° above the normal encloses nearly all of California and portions of Arizona and Nevada.

In districts east of the Rocky Mountains, except eastern Nova Scotia, the temperature is below the normal, the departures exceeding 2° over nearly all of the region named, while in the Lake region and central valleys they range from 4° to 8°.

The following are some of the most marked departures from the normal precipitation at Signal Service stations where the records cover eight, or more, years:

| Above normal. | | Below normal. | |
|--------------------------|------|------------------------|-----|
| Red Bluff, Cal. | 10.1 | Escanaba, Mich. | 8.1 |
| Sacramento, Cal. | 6.5 | Chicago, Ill. | 6.7 |
| Yuma, Ariz. | 5.8 | Detroit, Mich. | 6.5 |
| San Francisco, Cal. | 4.9 | La Crosse, Wis. | 6.5 |
| Winnemucca, Nev. | 4.3 | Davenport, Iowa. | 6.5 |
| Los Angeles, Cal. | 3.8 | Toledo, Ohio. | 5.9 |
| Roseburg, Oregon. | 2.7 | Saint Paul, Minn. | 5.7 |
| San Diego, Cal. | 2.5 | Dubuque, Iowa. | 5.7 |

RANGES OF TEMPERATURE.

The monthly and the greatest and least daily ranges of temperature at Signal Service stations are given in the tables of miscellaneous meteorological data. The monthly ranges varied from 70° to 100° in the upper Missouri valley and thence westward to Idaho; they were least in southern Florida and on the west Gulf and Pacific coasts.

The following are some of the extremes:

| Greatest. | | Least. | |
|------------------------------|-------|-----------------------------|------|
| Fort Custer, Mont. | 100.5 | Eureka, Cal. | 16.9 |
| Fort Maginnis, Mont. | 87.9 | Key West, Fla. | 19.3 |
| Valentine, Nebr. | 84.5 | Tafcoosh Island, Wash. | 19.7 |
| Deadwood, Dak. | 81.9 | Fort Canby, Wash. | 29.9 |
| Poplar River, Mont. | 81.7 | Brownsville, Tex. | 35.2 |
| Saint Vincent, Minn. | 81.5 | Corpus Christi, Tex. | 35.2 |
| Fort Buford, Dak. | 80.1 | San Diego, Cal. | 35.2 |
| Fort Assinaboine, Mont. | 79.8 | Galveston, Tex. | 36.8 |

The greatest daily range of temperature reported from Signal Service stations was 55° at Boise City, Idaho; the least, 3°, occurred, at Block Island, R. I., Cape Henry, Va., Vicksburg, Miss., Brownsville, Tex., and Astoria, Oregon.

Table of comparative maximum and minimum temperatures for October.

| State or Territory. | Stations. | For 1887. | | Since establishment of station. | | | Length of record. |
|------------------------|----------------------|-----------|-------|---------------------------------|---------------|------|-------------------|
| | | Max. | Min. | Max. | Year. | Min. | Year. |
| Alabama | Mobile | 87.2 | 34.0 | 93.4 | 1884 | 34.0 | 1873 |
| Do | Montgomery .. | 86.2 | 32.0 | 92.1 | 1884 | 33.0 | 1873 |
| Arizona | Prescott | 88.0 | 28.8 | 86.0 | 1881 | 18.0 | 1880 |
| Do | Fort Apache | 88.0 | 28.1 | 86.9 | 1885 | 19.0 | 1880 |
| Arkansas | Fort Smith | 89.6 | 32.2 | 94.6 | 1884 | 31.0 | 1886 |
| Do | Little Rock | 89.3 | 33.1 | 90.0 | '81, '83, '84 | 33.1 | 1886 |
| California | San Francisco .. | 87.0 | 49.2 | 84.0 | 1871 | 45.0 | 1881 |
| Do | San Diego | 85.0 | 49.8 | 92.0 | 1879 | 44.0 | 1878 |
| Colorado | Denver | 85.1 | 7.8 | 86.0 | 1873 | 1.0 | 1873 |
| Do | Pike's Peak | 44.3 | 0.2 | 57.3 | 1880 | 17.0 | 1878 |
| Connecticut | New Haven | 74.7 | 24.9 | 86.0 | 1881 | 25.1 | 1886 |
| Do | New London | 73.3 | 29.9 | 82.7 | 1879 | 27.2 | 1883 |
| Dakota | Fort Buford | 80.4 | 0.3 | 95.0 | 1879 | 9.0 | 1881 |
| Do | Yankton | 80.2 | 13.3 | 89.0 | 1879 | 9.0 | 1878 |
| Dis. of Columbia | Washington City .. | 85.2 | 30.9 | 92.3 | 1881 | 26.0 | 1873 |
| Florida | Jacksonville | 87.9 | 40.0 | 92.0 | 1883 | 40.0 | 1873 |
| Do | Key West | 86.4 | 67.1 | 92.0 | 1876 | 65.0 | 1873 |
| Georgia | Atlanta | 82.1 | 30.1 | 90.8 | 1884 | 33.6 | 1884 |
| Do | Savannah | 85.0 | 41.8 | 92.0 | 1884 | 37.0 | 1873 |
| Idaho | Boise City | 87.4 | 16.4 | 85.0 | 1879, 1880 | 19.0 | 1878 |
| Illinois | Chicago | 82.5 | 27.7 | 88.0 | 1872, 1881 | 24.0 | 1873 |
| Do | Indianapolis | 82.0 | 14.2 | 84.0 | 1879 | 25.0 | 1873 |
| Indiana | Indianapolis | 82.4 | 22.3 | 87.0 | 1884 | 23.0 | 1878 |
| Indian Ter. | Fort Sill | 88.7 | 30.7 | 91.0 | 1878, 1884 | 44.0 | 1878 |
| Iowa | Dubuque | 85.1 | 14.6 | 86.0 | 1879 | 20.0 | 1873 |
| Do | Des Moines | 82.6 | 13.8 | 85.8 | 1884 | 15.0 | 1878 |
| Kansas | Dodge City | 92.4 | 21.6 | 90.0 | 1883 | 10.0 | 1878 |
| Do | Leavenworth | 89.3 | 23.0 | 89.0 | 1871, 1874 | 19.0 | 1873 |
| Kentucky | Louisville | 84.0 | 25.5 | 90.0 | 1884 | 27.0 | 1878 |
| Louisiana | New Orleans | 86.0 | 41.8 | 90.0 | 1884 | 40.0 | 1873 |
| Do | Shreveport | 91.2 | 37.8 | 95.0 | 1883 | 31.0 | 1873 |
| Maine | Eastport | 64.0 | 26.5 | 80.0 | 1879 | 24.0 | 1881 |
| Do | Portland | 69.3 | 37.9 | 83.0 | 1879, 1881 | 27.6 | 1886 |
| Maryland | Baltimore | 85.3 | 32.2 | 89.0 | 1879, 1881 | 30.0 | 1873, 1879 |
| Massachusetts | Boston | 73.1 | 27.2 | 90.0 | 1881 | 25.0 | 1879 |
| Michigan | Marquette | 76.7 | 12.5 | 87.0 | 1879 | 18.0 | 1878 |
| Do | Grand Haven | 76.0 | 20.2 | 80.0 | 1879 | 23.5 | 1885 |
| Minnesota | Saint Vincent | 71.2 | 10.3 | 81.6 | 1886 | 10.2 | 1884 |
| Do | Saint Paul | 72.4 | 11.5 | 87 | 1879 | 15.0 | 1878 |
| Mississippi | Vicksburg | 88.0 | 33.5 | 93.7 | 1886 | 34.0 | 1873 |
| Missouri | Saint Louis | 86.5 | 24.0 | 90.0 | 1879 | 25.0 | 1873 |
| Montana | Ft. Assinaboine .. | 76.8 | 30.0 | 83.0 | 1884, 1885 | 16.0 | 1881 |
| Do | Helena | 74.2 | 2.7 | 76.9 | 1885 | 10.0 | 1881 |
| Nebraska | North Platte | 85.0 | 9.1 | 89.0 | 1879 | 11.0 | 1878 |
| Do | Omaha | 81.0 | 15.8 | 87.0 | 1879 | 15.0 | 1878 |
| Nevada | Winnemucca | 87.0 | 17.6 | 84.0 | 1879 | 10.0 | 1878 |
| New Hampshire | Mt. Washington .. | ..... | ..... | 59.0 | 1871 | 3.0 | 1881 |
| New Jersey | Atlantic City | 77.0 | 34.5 | 83.0 | 1880 | 29.0 | 1879 |
| New Mexico | Santa Fe | 78.0 | 31.0 | 85.0 | 1878 | 16.0 | 1880 |
| New York | Buffalo | 69.4 | 24.4 | 83.0 | 1879 | 24.7 | 1884 |
| Do | New York City | 78.0 | 32.0 | 88.3 | 1881 | 31.0 | 1876 |
| North Carolina | Charlotte | 83.9 | 35.5 | 91.9 | 1884 | 30.0 | 1879 |
| Do | Wilmington | 85.3 | 34.8 | 92.5 | 1884 | 32.0 | 1876 |
| Ohio | Cincinnati | 81.4 | 26.1 | 87.7 | 1884 | 27.0 | 1873 |
| Do | Sandusky | 85.0 | 24.0 | 87.0 | 1879 | 30.0 | 78, '80, '84 |
| Oregon | Portland | 75.4 | 32.9 | 82.2 | 1885 | 31.0 | 1877 |
| Do | Roseburg | 82.0 | 26.5 | 90.9 | 1885 | 22.5 | 1881 |
| Pennsylvania | Pittsburg | 80.3 | 20.0 | 91.1 | 1884 | 28.0 | 73, '76, '78 |
| Do | Philadelphia | 84.2 | 30.6 | 87.0 | 1881 | 31.0 | 1873, 1876 |
| Rhode Island | Block Island | 70.5 | 36.0 | 75.4 | 1881 | 32.6 | 1884 |
| South Carolina | Charleston | 87.7 | 42.9 | 93.0 | 1883 | 39.0 | 1873 |
| Tennessee | Knoxville | 82.0 | 27.9 | 94.0 | 1884 | 25.0 | 1876 |
| Do | Memphis | 88.0 | 32.6 | 92.0 | 1879, 1884 | 29.0 | 1878 |
| Texas | Brownsville | 85.7 | 50.5 | 95.0 | 1877 | 49.0 | 1879 |
| Do | Fort Elliott | 89.3 | 25.3 | 88.0 | 1880 | 26.0 | 1880 |
| Utah | Salt Lake City | 85.2 | 27.5 | 83.0 | 1876 | 22.0 | 1878 |
| Virginia | Lynchburg | 88.2 | 30.0 | 91.3 | 1884 | 28.0 | 1879 |
| Do | Norfolk | 87.0 | 39.7 | 89.0 | 1881, 1884 | 31.0 | 1876 |
| Washington | Spokane Falls | 69.1 | 12.3 | 77.0 | 1886 | 18.0 | 1881 |
| Do | Olympia | 65.7 | 30.0 | 73.0 | 1880 | 23.0 | 1881 |
| Wisconsin | LaCrosse | 83.5 | 6.2 | 84.0 | 1884 | 15.0 | 1873 |
| Do | Milwaukee | 74.3 | 14.8 | 83.1 | 1884 | 22.0 | 1878 |
| Wyoming | Cheyenne | 81.6 | 4.3 | 80.0 | '73, '74, '79 | 4.0 | 1878 |

DEVIATIONS FROM NORMAL TEMPERATURES.

The following table shows for certain stations, as reported by voluntary observers, (1) the normal temperatures for a series of years; (2) the length of record during which the observations have been taken, and from which the normal has been computed; (3) the mean temperature for October, 1887; (4) the departures of the current month from the normal;

(5) and the extreme monthly means for October during the period of observations and the year of occurrence:

| State and Station. | County. | (1) Normal for the month of Oct. | (2) Length of record. | (3) Mean for October, 1887. | (4) Departure from normal. | (5) Extreme monthly mean temperature for October. | | | |
|------------------------|-------------|----------------------------------|-----------------------|-----------------------------|----------------------------|---|-------|---------|-------|
| | | | | | | Highest. | | Lowest. | |
| | | | | | | Am't. | Year. | Am't. | Year. |
| <i>California.</i> | | | | | | | | | |
| Sacramento | Sacramento | 60.5 | 21 | 58.4 | -2.1 | | | | |
| <i>Connecticut.</i> | | | | | | | | | |
| Middletown | Middlesex | 59.4 | 29 | 49.2 | -11.2 | | | | |
| New Haven | New Haven | 51.4 | 101 | 51.1 | -0.3 | | | | |
| Waterbury | New Haven | 53.2 | 12 | 48.0 | -5.2 | | | | |
| <i>Florida.</i> | | | | | | | | | |
| Archer | Alachua | 72.3 | 5 | 71.6 | -0.7 | | | | |
| <i>Illinois.</i> | | | | | | | | | |
| Aurora | Kane | 52.4 | 9 | 46.2 | -6.2 | | | | |
| Golconda | Pope | 51.8 | 9 | 55.4 | +3.6 | | | | |
| Greenville | Bond | 57.6 | 9 | 50.8 | -6.8 | | | | |
| Mattoon | Coles | 52.1 | 6 | 48.0 | -4.1 | | | | |
| Peoria | Peoria | 54.0 | 32 | 50.4 | -3.6 | | | | |
| Riley | McHenry | 47.5 | 26 | 43.2 | -4.3 | | | | |
| Sumner | Lawrence | 49.9 | 7 | 43.8 | -6.1 | | | | |
| <i>Indiana.</i> | | | | | | | | | |
| Blue Lick | Clark | 58.7 | 10 | 52.3 | -6.4 | | | | |
| Connorsville | Fayette | 52.8 | 6 | 48.7 | -4.1 | | | | |
| Lafayette | Tippecanoe | 52.5 | 8 | 52.1 | -0.4 | 59.5 | 1881 | 42.0 | 1864 |
| Logansport | Cass | 53.2 | 33 | 50.5 | -2.7 | | | | |
| Summan | Ripley | 53.8 | 5 | 51.3 | -2.5 | | | | |
| Vevay | Switzerland | 56.2 | 21 | 52.6 | -3.6 | | | | |
| Worthington | Greene | 55.8 | 6 | 52.6 | -3.2 | | | | |
| <i>Iowa.</i> | | | | | | | | | |
| Cresco | Howard | 46.6 | 10 | 41.9 | -4.7 | | | | |
| <i>Kansas.</i> | | | | | | | | | |
| Independence | Montgomery | 58.2 | 16 | 54.8 | -3.4 | | | | |
| Lawrence | Douglas | 54.5 | 20 | 52.0 | -2.5 | 60.5 | 1879 | 44.0 | 1860 |
| Wellington | Summan | 56.7 | 9 | 56.4 | -0.3 | 60.6 | 1884 | 50.3 | 1880 |
| Yates Centre | Woodson | 55.1 | 7 | 52.4 | -2.7 | 58.8 | 1884 | 50.5 | 1885 |
| <i>Maine.</i> | | | | | | | | | |
| Belfast | Waldo | 47.1 | 28 | 46.4 | -0.7 | | | | |
| Cornish | York | 47.7 | 30 | 45.1 | -2.6 | 52.6 | 1879 | 40.9 | 1864 |
| Gardiner | Kennebec | 47.3 | 51 | 46.2 | -1.1 | | | | |
| Orono | Penobscot | 47.1 | 19 | 44.7 | -2.4 | | | | |
| <i>Maryland.</i> | | | | | | | | | |
| Fallston | Harford | 55.4 | 17 | 52.9 | -2.5 | 62.2 | 1879 | 48.5 | 1876 |
| <i>Massachusetts.</i> | | | | | | | | | |
| Amherst | Hampshire | 48.8 | 50 | 48.4 | -0.4 | | | | |
| Cambridge | Middlesex | 50.3 | 65 | 50.0 | -0.3 | | | | |
| Fitchburg | Worcester | 48.3 | 31 | 46.6 | -1.7 | | | | |
| New Bedford | Bristol | 52.1 | 76 | 50.3 | -1.8 | | | | |
| Somerset | Bristol | 53.3 | 17 | 52.6 | -0.7 | | | | |
| Taunton | Bristol | 52.9 | 16 | 50.3 | -2.6 | | | | |
| Springfield | Hampden | 51.2 | 20 | 49.9 | -1.3 | | | | |
| <i>Nevada.</i> | | | | | | | | | |
| Carson City | Ormsby | 47.6 | 8 | 49.2 | +1.6 | | | | |
| <i>New Brunswick.</i> | | | | | | | | | |
| Saint John | Saint John | 45.9 | 27 | 45.5 | -0.4 | | | | |
| <i>New Jersey.</i> | | | | | | | | | |
| Dover | Morris | 51.9 | 5 | 48.5 | -3.4 | | | | |
| South Orange | Essex | 53.5 | 18 | 53.0 | -0.5 | | | | |
| <i>New York.</i> | | | | | | | | | |
| Factoryville | Tioga | 48.8 | 7 | 46.1 | -2.7 | | | | |
| Humphrey | Cattaraugus | 47.4 | 4 | 45.2 | -2.2 | 49.2 | 1886 | 45.1 | 1883 |
| Palermo | Oswego | 46.9 | 34 | 41.9 | -5.0 | 53.9 | 1879 | 39.3 | 1873 |
| <i>Ohio.</i> | | | | | | | | | |
| Wauseon | Fulton | 51.3 | 17 | 46.5 | -4.8 | 59.0 | 1879 | 46.0 | 1875 |
| <i>Pennsylvania.</i> | | | | | | | | | |
| Corry | Erie | 52.2 | 7 | 51.0 | -1.2 | 55.9 | 1881 | 48.6 | 1885 |
| Dyberry | Wayne | 44.5 | 20 | 46.2 | +1.7 | 53.4 | 1879 | 41.8 | 1869 |
| <i>South Carolina.</i> | | | | | | | | | |
| Stateburg | Sumter | 64.6 | 7 | 60.6 | -4.0 | 69.0 | 1881 | 59.8 | 1885 |
| <i>Texas.</i> | | | | | | | | | |
| New Ulm | Austin | 69.7 | 16 | 67.0 | -2.7 | | | | |
| <i>Vermont.</i> | | | | | | | | | |
| Lunenburg | Essex | 44.7 | 38 | 43.6 | -1.1 | | | | |
| Newport | Orleans | 46.2 | 12 | 44.5 | -1.7 | | | | |
| Stratford | Orange | 47.4 | 13 | 45.9 | -1.5 | | | | |
| <i>Virginia.</i> | | | | | | | | | |
| Bird's Nest | Northampton | 61.9 | 19 | 61.3 | -0.6 | | | | |
| Dale Enterprise | Rockingham | | | | | 64.7 | 1883 | 52.6 | 1880 |
| Variety Mills | Nelson | 57.1 | 10 | 52.0 | -5.1 | 61.9 | 1881 | 52.0 | 1885 |
| Wytheville | Wythe | 53.7 | 23 | 51.2 | -2.5 | | | | |
| <i>West Virginia.</i> | | | | | | | | | |
| Helvetia | Randolph | 52.0 | 11 | 48.9 | -3.1 | 56.8 | 1881 | 47.0 | 1885 |

LOW TEMPERATURES.

Milwaukee, Wis.: the minimum temperature for the month, 15°, occurred on the 25th; this is the lowest temperature that has been recorded here in October since the establishment of the signal office in 1870; the next lowest October temperature, 22°, occurred in 1878.

Clinton, Clinton Co., Iowa: freezing weather prevailed on fifteen days during the month; so great a number of days with freezing temperature has not previously occurred in October during the nine years of record at this station.

FROST.

Frost occurred in the several states and territories during the month as follows:

1st.—Colo., Nebr.

2d.—Ind. T., Mont., Nebr., Oregon, Va.

3d.—Dak., Mont., Nebr., Nev., Oregon, Va.

4th.—Dak., Iowa, Minn., Nebr., Wyo.

5th.—Ill., Ind., Iowa, Ky., Minn., Oregon, Pa., Tenn., Wash., Wis.

6th.—Dak., Ga. (Forsyth), Minn., Mont., N. C., Ohio, Oregon, Tenn., Va., W. Va.

7th.—Cal., Dak., Idaho, Mont., Nev., Oregon, Wash., W. Va., Wyo.

8th.—Ariz., Cal., Dak., Idaho, Mont., Nev., Oregon, Wyo.

9th.—Ariz., Colo, Dak., Minn., Mont., Nebr., Nev., Oregon, Wyo.

10th.—Ariz., Colo., Dak., Iowa, Kans., Mich., Mont., Nebr., Oregon, Utah, Wash., Wyo.

11th.—Colo., Dak., Ill., Ind., Ind. T., Iowa, Kans., Ky., Mich., Minn., Mo., Mont., Nebr., Nev., Ohio, Oregon, Tenn., Wash., Wis., Wyo.

12th.—Ark. (Fort Smith, Hot Springs, and Lead Hill), Colo., Conn., Del., Ga. (Forsyth), Ill., Ind., Ind. T., Iowa, Kans., Ky., Me., Md., Mass., Mich., Minn., Miss. (University), Mo., Mont., Nebr., N. H., N. J., N. Y., N. C., Ohio, Oregon, Pa., R. I., S. C. (Cedar Springs), Tenn., Wash., W. Va., Wis., Wyo.

13th.—Ala. (Livingston), Ariz., Ark. (Lead Hill), Conn., Dak., D. C., Ga. (Atlanta and Forsyth), Ill., Ind., Iowa, Kans., La. (Shreveport), Me., Md., Mass., Mich., Miss. (University and Vicksburg), Mo., Mont., Nebr., N. H., N. J., N. C., Ohio, Oregon, Pa., R. I., Tenn., Va., Wash., W. Va., Wyo.

14th.—Ariz., Conn., Dak., D. C., Ill., Ind., Iowa, Kans., Ky., Me., Md., Mass., Mich., Minn., Mont., Nebr., Nev., N. H., N. J., N. Y., N. C., Ohio, Oregon, Pa., R. I., Tenn., Vt., Va., W. Va., Wis., Wyo.

15th.—Ariz., Ark. (Lead Hill), Cal., Colo., Conn., Dak., D. C., Ill., Ind., Iowa, Ky., Me.; Md., Mass., Mich., Mont., Nev., N. H., N. J., N. Mex., N. Y., N. C., Ohio, Oregon, Pa., R. I., S. C. (Cedar Springs), Tenn., Vt., Va., Wash., W. Va., Wis.

16th.—Ariz., Cal., Colo., Conn., Dak., D. C., Ind., Ind. T., Iowa, Ky., Me., Md., Mass., Mich., Minn., Mo., Mont., Nebr., Nev., N. H., N. J., N. Y., N. C., Ohio, Oregon, Pa., R. I., S. C. (Columbia and Cedar Springs), Tenn., Vt., Va., Wash., W. Va., Wis.

17th.—Ariz., Colo., Dak., Iowa, Kans., Mass., Md., Minn., Mont., Nebr., Nev., N. H., N. Y., Ohio, Oregon, Pa., Tenn., Utah, Vt., Va., Wash., W. Va., Wis., Wyo.

18th.—Ariz., Cal., Colo., Dak., Ill., Iowa, Kans., Ky., Mich., Minn., Mo., Mont., Nebr., Nev., Ohio, Oregon, Utah, Wis.

19th.—Ariz., Ark. (Lead Hill), Colo., Ill., Ind., Iowa, Ky., Me., Mich., Mo., Mont., Nev., N. Mex., N. Y., Ohio, Oregon, Pa., Tex., Vt., Wash., Wis.

20th.—Ariz., Cal., Colo., Conn., Dak., Ind., Iowa, Kans., Me., Mass., Mich., Mont., Nebr., Nev., N. H., N. J., N. Mex., N. Y., Ohio, Oregon, Pa., Vt., Wash., Wis., Wyo.

21st.—Ariz., Ark. (Fort Smith and Lead Hill), Cal., Dak., Ind., Ind. T., Iowa, Kans., Mich., Minn., Mo., Mont., Nebr., Nev., N. Mex., Ohio, Oregon, Tenn., Tex., Va., Wis.

22d.—Ark. (Lead Hill), Cal., Colo., Conn., Dak., D. C., Ga. (Atlanta, Augusta, Milledgeville, and Quitman), Ill., Ind., Iowa, Ky., Me., Md., Mich., Minn., Miss. (University), Mo., Mont., Nebr., Nev., N. J., N. Mex., N. Y., N. C., Ohio, Oregon, Pa., S. C. (Charleston, Columbia, and Stateburg), Tenn., Vt., Va., W. V., Wis., Wyo.

23d.—Cal., Colo., Conn., Dak., D. C., Idaho, Iowa, Me., Md., Mass., Mich., Mont., Nebr., Nev., N. H., N. J., N. Y., N. C., Ohio, Oregon, Pa., S. C. (Cedar Springs), Tenn., Vt., Va., Wash., W. Va., Wis., Wyo.

24th.—Cal., Colo., Dak., Fla. (Jacksonville), Ill., Ind., Ind. T., Iowa, Kans., Mich., Minn., Mo., Mont., Nebr., Nev., Ohio, Oregon, Tenn., Tex., Wash., Wis., Wyo.

25th.—Cal., Colo., Dak., Ill., Ind., Ind. T., Iowa, Kans., Me., Mass., Mich., Minn., Mo., Mont., Nebr., Nev., N. Mex., N. Y., Ohio, Oregon, Pa., Tenn., Tex., Vt., Va., Wash., Wis., Wyo.

26th.—Ariz., Cal., Colo., Dak., Ill., Ind., Ind. T., Iowa, Kans., Me., Mass., Mich., Mont., Nebr., Nev., N. H., N. J., N. Y., Ohio, Oregon, Pa., Tenn., Vt., Wis., Wyo.

27th.—Ariz., Cal., Colo., Dak., Ill., Ind. T., Iowa, Kans., Me., Mass., Mich., Minn., Mo., Nebr., Nev., N. Mex., N. O., Ohio, Oregon, Pa., Tenn., Tex., Vt., Wis., Wyo.

28th.—Ariz., Ark. (Fort Smith), Cal., Colo., Dak., Ill., Ind., Ind. T., Iowa, Kans., Mich., Nev., N. Mex., N. Y., Ohio, Oregon, Pa., Tenn., Tex., Wis., Wyo.

29th.—Ariz., Ark. (Lead Hill), Cal., Colo., Dak., Ill., Ind. T., Iowa, Kans., Me., Mass., Mich., Minn., Mo., Mont., Nebr., Nev., N. H., N. Mex., Ohio, Oregon, Pa., Tenn., Tex., Vt., Wis., Wyo.

30th.—Ariz., Ark. (Lead Hill and Little Rock), Cal., Colo., Dak., Ill., Ind., Ind. T., Iowa, Kans., Mass., Mich., Minn., Miss. (Vicksburg), Mo., Mont., Nebr., Nev., N. H., N. Mex., N. Y., Ohio, Oregon, Pa., Tenn., Tex., Vt., Wash., W. Va., Wis.

31st.—Ala. (Livingston, Mobile, and Montgomery), Ariz., Ark. (Lead Hill), Cal., Dak., Fla., (Archer, Jacksonville, Pensacola, and Tallahassee), Ga., (Atlanta, Quitman, and Savannah), Ill., Ind., Ind. T., Iowa, Kans., Ky., La., (Shreveport), Me., Md., Mass., Mich., Minn., Miss. (Biloxi, University, and Vicksburg), Mo., Mont., Nebr., Nev., N. H., N. J., N. Mex., Ohio, Oregon, Pa., Tenn., Tex., Vt., Va., Wash., W. Va., Wis., Wyo.

ICE.

The formation of ice in the southern parts of the country occurred on the following dates:

Ashwood, Tenn., 13th, 22d; Austin, Tenn., 15th, 23d; Charlotte, N. C., 16th; Prescott, Ariz., 20th; Nashville, Tenn., 22d, 31st; Milan, Tenn., 30th, 31st; Quitman and Atlanta, Ga., University of Mississippi, Miss., and Chattanooga, Tenn., 31st.

TEMPERATURE OF WATER.

The following table shows the maximum, minimum, and mean water temperature, as observed at the harbors of the several stations; the monthly range of water temperature; the average depth at which the observations were made, and the mean temperature of the air:

Temperature of water for October, 1887.

| Station. | Temperature at bottom. | | | | Mean temperature of air at the station. | Average depth of water in fathoms and hundredths |
|------------------------|------------------------|------|--------|---------------|---|--|
| | Max. | Min. | Range. | Monthly mean. | | |
| Canby, Fort, Wash..... | 58.1 | 50.1 | 8.0 | 54.3 | 14.8 | 53.2 |
| Cedar Keys, Fla..... | 75.0 | 63.3 | 11.7 | 70.0 | 66.0 | 36.8 |
| Charleston, S. C..... | 51.6 | 48.5 | 3.1 | 50.3 | 46.4 | 16.5 |
| Eastport, Me..... | 80.4 | 58.4 | 22.0 | 70.5 | 69.4 | 15.1 |
| Galveston, Tex..... | 86.0 | 72.4 | 13.6 | 81.6 | 78.9 | 20.3 |
| Key West, Fla..... | 63.1 | 54.2 | 8.9 | 59.7 | 53.1 | 12.2 |
| New London, Conn..... | 62.8 | 52.9 | 9.9 | 58.8 | 54.7 | 14.9 |
| New York City..... | 77.6 | 65.6 | 12.0 | 73.0 | 68.2 | 17.9 |
| Pensacola, Fla..... | 54.4 | 47.1 | 7.3 | 51.1 | 47.6 | 16.5 |
| Portland, Me..... | 61.0 | 51.2 | 9.8 | 56.3 | 53.8 | 52.9 |
| Portland, Oregon..... | | | | | | |

PRECIPITATION (expressed in inches and hundredths).

The distribution of precipitation over the United States and Canada for October, 1887, as determined from the reports of about eight hundred stations, is exhibited on chart iv. In the table of miscellaneous meteorological data are given, for each Signal Service station, the total precipitation, with the departures from the normal. The figures opposite the names of the geographical districts in columns for mean temperature, precipitation, and departures from the normal, show respectively the averages for the several districts. The normal for any district may be found by adding the departure to the current mean when the precipitation is below the normal, and subtracting when above.

The precipitation over the greater part of the United States, as compared with the normal, is deficient. The districts where an excess is shown are: Eastern Montana and adjacent portions of Dakota; southern Colorado and northern New Mexico; southeastern Kansas, Indian Territory, and central-northern Texas; the lower Rio Grande Valley; the eastern Gulf and south Atlantic states, except northern Florida; and over the Gulf of Saint Lawrence. An excess of more than one inch over the average precipitation for October occurs in the south Atlantic states. The precipitation in the southern portions of Louisiana and Mississippi is very heavy, the excess at New Orleans amounting to 1.54, and at voluntary stations in southern Mississippi the rainfall is more than double the amount which fell at New Orleans. Over an area extending from southeastern Kansas to central Texas, and in the lower Rio Grande valley, the monthly rainfalls are also exceptionally heavy, the excess at several stations in the regions named amounting to more than two inches. At Brownsville, Tex., the monthly rainfall is 16.27, nearly twelve inches in excess of the October average for the eleven preceding years.

As previously stated, the area of deficiency is much greater than that of excessive rainfall. On the Pacific coast, in the northern and middle plateau districts, and over the entire

region from the Missouri and central Mississippi valleys eastward to the Atlantic coast, the rainfall is decidedly below the average. The precipitation in New England and the lower lake region is about 65 per cent. of the normal, while in the Ohio and upper Mississippi valleys it is less than 50 per cent. Over a large part of California there was an almost entire absence of rainfall during the month, the October average of former years in the northern part of the state being slightly more than an inch, and that for the southern part of the state about four-tenths of an inch. While a deficiency of nearly one inch is shown for the north Pacific coast region (the normal being about 4.50), in the extreme northwestern part of Washington Territory the rainfall is very heavy, Tatoosh Island and Neah Bay reporting 11.83 and 14.84, respectively. This area of heavy rainfall, however, extends but a short distance inland from the coast, as shown by reports from neighboring stations. At Port Angeles, about fifty miles east of Neah Bay, the rainfall is less than three inches, and at Olympia it is but 1.51.

The following are some of the most marked departures from normal precipitation as reported from Signal Service stations:

| Above normal. | | Below normal. | |
|---------------------------|---------|------------------------|---------|
| | Inches. | | Inches. |
| Brownsville, Tex..... | 11.63 | Jacksonville, Fla..... | 4.42 |
| Charlotte, N. C..... | 4.75 | Springfield, Ill..... | 3.27 |
| Tatoosh Island, Wash..... | 4.67 | Portland, Oregon..... | 3.19 |
| Hatteras, N. C..... | 4.55 | Des Moines, Iowa..... | 3.03 |
| Augusta, Ga..... | 4.45 | Cedar Keys, Fla..... | 2.95 |
| Key West, Fla..... | 3.91 | Louisville, Ky..... | 2.93 |
| Fort Gibson, Ind. T..... | 3.30 | Cincinnati, Ohio..... | 2.91 |
| Cape Henry, Va..... | 2.86 | Olympia, Wash..... | 2.54 |
| Norfolk, Va..... | 2.84 | Fort Elliott, Tex..... | 2.44 |
| Abilene, Tex..... | 2.35 | Omaha, Nebr..... | 2.32 |

DEVIATIONS FROM AVERAGE PRECIPITATION.

The following table shows for certain stations, as reported by voluntary observers, (1) the average precipitation for a series of years; (2) the length of record during which the observations have been taken, and from which the average has been computed; (3) the total precipitation for October, 1887; (4) the departures of the current month from the average; (5) and the extreme monthly precipitation for October during the period of observations and the year of occurrence:

Deviations from average precipitation.

| State and station. | County. | (1) Average for the month of October. | | | | (4) Extreme monthly precipitation for October. | | | |
|----------------------|-------------------|---------------------------------------|-----------------------|------------------------------|-----------------------------|--|-------|---------|-------|
| | | (1) Average for the month of October. | (2) Length of record. | (3) Total for October, 1877. | (4) Departure from average. | Greatest. | | Least. | |
| | | | | | | Am't. | Year. | Am't. | Year. |
| Arkansas. | | Inches | Years | Inches | Inches. | Inches | | Inches. | |
| Lead Hill..... | Boone..... | 5.63 | 6 | 1.50 | -4.13 | 18.11 | 1883 | 0.10 | 1886 |
| California. | | | | | | | | | |
| Sacramento..... | Sacramento..... | 0.73 | 21 | 0.00 | -0.73 | | | | |
| Connecticut. | | | | | | | | | |
| Canton..... | Hartford..... | 4.91 | 26 | 2.90 | -2.01 | | | | |
| Hartford..... | Hartford..... | 3.23 | 15 | 2.50 | -0.73 | | | | |
| Middletown..... | Middlesex..... | 3.86 | 29 | 3.32 | -0.54 | | | | |
| Wallingford..... | New Haven..... | 3.98 | 29 | 3.25 | -0.73 | | | | |
| Florida. | | | | | | | | | |
| Archer..... | Alachua..... | 2.33 | 5 | 1.19 | -1.14 | | | | |
| Illinois. | | | | | | | | | |
| Aurora..... | Kane..... | 3.88 | 9 | 3.54 | -0.34 | | | | |
| Golconda..... | Pope..... | 4.02 | 9 | 0.04 | -3.98 | | | | |
| Mattoon..... | Coles..... | 4.38 | 8 | 0.97 | -3.41 | | | | |
| Oswego..... | Kendall..... | 3.90 | 7 | 1.95 | -1.95 | | | | |
| Peoria..... | Peoria..... | 2.57 | 32 | 2.14 | -0.43 | | | | |
| Riley..... | McHenry..... | 2.61 | 28 | 2.75 | +0.14 | | | | |
| Sycamore..... | De Kalb..... | 4.96 | 7 | 2.80 | -2.16 | | | | |
| Indiana. | | | | | | | | | |
| Blue Lick..... | Clark..... | 2.92 | 10 | 0.60 | -2.32 | 7.16 | 1883 | 0.60 | 1887 |
| Connersville..... | Fayette..... | 2.49 | 6 | 0.63 | -1.86 | 6.51 | 1883 | 0.63 | 1887 |
| Lafayette..... | Tippecanoe..... | 2.85 | 8 | 1.62 | -1.23 | 5.56 | 1883 | 0.70 | 1886 |
| Logansport..... | Cass..... | 2.70 | 33 | 1.90 | -0.80 | 6.98 | 1877 | 1.00 | 1874 |
| Mausy..... | Rush..... | 2.88 | 8 | 0.61 | -2.27 | 7.88 | 1883 | 0.61 | 1887 |
| Sunman..... | Ripley..... | 2.27 | 5 | 0.74 | -1.53 | 5.75 | 1883 | 0.74 | 1887 |
| Vevay..... | Switzerland..... | 2.65 | 21 | 0.67 | -1.98 | 7.67 | 1883 | 0.28 | 1879 |
| Worthington..... | Greene..... | 3.06 | 6 | 1.13 | -1.93 | 9.53 | 1883 | 0.28 | 1879 |
| Iowa. | | | | | | | | | |
| Cresco..... | Howard..... | 2.56 | 14 | 1.53 | -1.03 | | | | |
| Kansas. | | | | | | | | | |
| Independence..... | Montgomery..... | 2.94 | 15 | 2.61 | -0.33 | | | | |
| Lawrence..... | Douglas..... | 2.88 | 20 | 3.83 | +0.95 | 6.96 | 1870 | 0.44 | 1878 |
| Wellington..... | Sunman..... | 3.72 | 9 | 6.06 | +2.34 | | | | |
| Yates Centre..... | Woodson..... | 3.49 | 7 | 1.91 | -1.58 | 8.52 | 1881 | 1.16 | 1886 |
| Maine. | | | | | | | | | |
| Cornish..... | York..... | 4.00 | 30 | 2.04 | -1.96 | | | | |
| Gardiner..... | Kennebec..... | 4.45 | 49 | 2.44 | -2.01 | | | | |
| Lewiston..... | Androscoggin..... | 4.01 | 13 | 2.42 | -1.59 | | | | |
| Orono..... | Penobscot..... | 4.42 | 19 | 3.00 | -1.42 | | | | |
| Maryland. | | | | | | | | | |
| Fallston..... | Harford..... | 3.38 | 17 | 1.37 | -2.01 | 7.56 | 1873 | 0.23 | 1874 |
| Massachusetts. | | | | | | | | | |
| Amherst..... | Hampshire..... | 3.74 | 53 | 2.21 | -1.53 | | | | |
| Cambridge..... | Middlesex..... | 3.39 | 47 | 3.36 | -0.03 | | | | |
| Chestnut Hill..... | Middlesex..... | 3.73 | 12 | 3.31 | -0.42 | | | | |
| Framingham..... | Middlesex..... | 3.86 | 13 | 3.87 | -0.01 | | | | |
| Lake Cochituate..... | Middlesex..... | 4.12 | 36 | 2.49 | -1.63 | | | | |
| Ludlow..... | Hampden..... | 3.09 | 12 | 2.05 | -1.04 | | | | |
| Lynn..... | Essex..... | 3.64 | 13 | 2.92 | -0.72 | | | | |
| Mystic Lake..... | Middlesex..... | 3.45 | 12 | 3.06 | -0.39 | | | | |
| New Bedford..... | Bristol..... | 3.81 | 75 | 3.95 | +0.14 | | | | |
| Somerset..... | Bristol..... | 3.85 | 17 | 2.64 | -1.21 | | | | |
| Springfield..... | Hamden..... | 4.11 | 40 | 1.90 | -2.21 | | | | |
| Waltham..... | Middlesex..... | 3.65 | 63 | 2.91 | -0.74 | | | | |
| Nevada. | | | | | | | | | |
| Carson City..... | Ormsby..... | 0.41 | 9 | 0.04 | -0.37 | | | | |
| New Brunswick. | | | | | | | | | |
| Saint John's..... | Saint John's..... | 4.60 | 27 | 3.70 | -0.90 | | | | |
| New Hampshire. | | | | | | | | | |
| Concord..... | Merrimack..... | 3.80 | 32 | 1.71 | -2.09 | | | | |
| Hanover..... | Grafton..... | 2.73 | 23 | 1.89 | -0.84 | | | | |
| New Jersey. | | | | | | | | | |
| Dover..... | Morris..... | 3.88 | 5 | 1.99 | -1.89 | | | | |
| South Orange..... | Essex..... | 3.39 | 18 | 1.90 | -1.49 | | | | |
| New York. | | | | | | | | | |
| Factoryville..... | Tioga..... | 2.45 | 6 | 2.11 | -0.34 | | | | |
| Humphrey..... | Cattaraugus..... | 3.24 | 4 | 3.96 | +0.72 | 4.17 | 1885 | 1.55 | 1886 |
| Palermo..... | Oswego..... | 3.47 | 34 | 1.93 | -1.54 | 7.90 | 1882 | 0.30 | 1882 |
| Ohio. | | | | | | | | | |
| North Lewisburg..... | Champaign..... | 2.28 | 16 | 0.45 | -1.83 | | | | |
| Wansee..... | Fulton..... | 2.95 | 15 | 1.97 | -0.98 | 8.92 | 1881 | 0.93 | 1874 |
| Pennsylvania. | | | | | | | | | |
| Dyberry..... | Wayne..... | 3.06 | 17 | 1.24 | -1.82 | | | | |
| South Carolina. | | | | | | | | | |
| Kirkwood..... | Kershaw..... | 2.47 | 20 | 7.23 | +4.76 | 14.75 | 1878 | 0.04 | 1884 |
| Stateburg..... | Sumter..... | 3.08 | 7 | 8.15 | +5.07 | 3.52 | 1885 | 0.02 | 1884 |
| Texas. | | | | | | | | | |
| New Ulm..... | Austin..... | 4.04 | 16 | 2.70 | -1.34 | 12.44 | 1881 | 0.79 | 1874 |
| Vermont. | | | | | | | | | |
| Lunenburg..... | Essex..... | 3.61 | 38 | 2.39 | -1.22 | | | | |
| Newport..... | Orleans..... | 3.92 | 12 | 1.83 | -2.09 | | | | |
| Strafford..... | Orange..... | 3.98 | 13 | 2.87 | -1.11 | 5.30 | 1877 | 1.20 | 1882 |
| Virginia. | | | | | | | | | |
| Bird's Nest..... | Northampton..... | 3.09 | 19 | 1.37 | -1.72 | | | | |
| Dale Enterprise..... | Rockingham..... | 2.05 | 7 | 1.55 | -0.50 | 12.63 | 1885 | 0.96 | 1884 |
| Variety Mills..... | Nelson..... | 3.54 | 8 | 3.30 | -0.24 | 10.76 | 1885 | 0.96 | 1884 |
| Wytheville..... | Wythe..... | 2.95 | 23 | 3.46 | +0.51 | | | | |
| West Virginia. | | | | | | | | | |
| Helvetia..... | Randolph..... | 3.26 | 11 | 1.20 | -2.06 | 5.80 | 1885 | 1.30 | 1885 |

EXCESSIVE MONTHLY PRECIPITATION FOR OCTOBER.

With a view to the arrangement of the rainfall data of this office in such a manner as would best tend to the interests and add to the information of the engineers of the country and other classes interested in extreme rainfalls, there has been collated for the month of October for a series of years (for the

most part ranging from ten to sixteen) data showing the greatest rainfall that has occurred in any October; cases in which 2.50 inches of rain have fallen in twenty-four hours, and also instances where the rain has been so excessive as to equal or exceed the rate of an inch per hour. These data apply only to extreme cases in October, and while they give a general idea of extreme amounts of precipitation for month, day, and short periods of time, yet the lack of rainfall stations and long records prevent the data from being entirely exhaustive.

It is found that rainfalls exceeding ten inches have occurred in October at various points contiguous to the sea coast of New England and at scattered points throughout the whole extent of the south Atlantic and Gulf states, as well as on the Pacific coast northward of the fortieth parallel. In central Illinois and northern Arkansas, amounts exceeding ten inches have also fallen.

The following table shows for October all monthly rainfalls exceeding ten inches, as well as the maximum amount fallen, at any station in the various states and territories:

| State or territory. | Station. | Am't. | Year. | State or territory. | Station. | Am't. | Year. |
|---------------------|-----------------------|-------|-------|---------------------|------------------------|-------|-------|
| Alabama..... | Montgomery..... | 10.20 | 1879 | Montana..... | Fort Maginnis..... | 4.06 | 1883 |
| Do..... | Greensborough..... | 9.85 | 1879 | Nebraska..... | Omaha..... | 5.86 | 1877 |
| Do..... | Green Springs..... | 9.85 | 1879 | Nevada..... | Fort McDermitt..... | 6.33 | 1883 |
| Arizona..... | Fort Apache..... | 4.68 | 1880 | N. Hampshire..... | Mt. Washington..... | 18.28 | 1881 |
| Arkansas..... | Lead Hill..... | 18.11 | 1883 | Do..... | Do..... | 12.91 | 1884 |
| California..... | Fort Gaston..... | 12.50 | 1876 | Do..... | Do..... | 11.11 | 1885 |
| Do..... | Do..... | 9.02 | 1882 | Do..... | Weir's Bridge..... | 11.80 | 1869 |
| Colorado..... | Pike's Peak..... | 4.64 | 1880 | Do..... | Lake Village..... | 11.54 | 1869 |
| Connecticut..... | New Haven..... | 10.09 | 1887 | New Jersey..... | Orange..... | 7.19 | 1887 |
| Dakota..... | Webster..... | 9.39 | 1882 | New Mexico..... | Santa Fé..... | 4.19 | 1881 |
| Dis. of Colum..... | Washington City..... | 8.69 | 1885 | New York..... | Rochester..... | 8.67 | 1873 |
| Florida..... | Key West..... | 9.27 | 1870 | N. Carolina..... | Salisbury..... | 14.19 | 1887 |
| Do..... | Do..... | 14.20 | 1879 | Do..... | Weldon..... | 9.97 | 1887 |
| Do..... | Do..... | 19.77 | 1883 | Do..... | Hatteras..... | 9.99 | 1878 |
| Do..... | Jacksonville..... | 9.45 | 1879 | Do..... | Do..... | 12.00 | 1880 |
| Do..... | Do..... | 16.25 | 1880 | Do..... | Do..... | 10.28 | 1885 |
| Do..... | Do..... | 10.30 | 1882 | Do..... | Do..... | 11.07 | 1887 |
| Do..... | Cedar Keys..... | 10.37 | 1880 | Do..... | Raleigh..... | 10.23 | 1887 |
| Do..... | Merritt's Island..... | 11.30 | 1879 | Do..... | Chapel Hill..... | 11.21 | 1887 |
| Do..... | Do..... | 11.82 | 1883 | Do..... | Lumberton..... | 9.51 | 1887 |
| Georgia..... | Savannah..... | 9.45 | 1877 | Ohio..... | Wauseon..... | 8.92 | 1881 |
| Do..... | Leo..... | 10.05 | 1879 | Oregon..... | Astoria..... | 13.40 | 1875 |
| Do..... | Rabun Gap..... | 19.40 | 1879 | Do..... | Do..... | 14.20 | 1876 |
| Do..... | Ellerslie..... | 10.50 | 1885 | Do..... | Portland..... | 10.53 | 1876 |
| Idaho..... | Boise City..... | 4.66 | 1883 | Do..... | Do..... | 11.63 | 1882 |
| Illinois..... | Springfield..... | 10.02 | 1881 | Pennsylvania..... | Erie..... | 8.17 | 1885 |
| Do..... | Mattoon..... | 11.25 | 1881 | Rhode Island..... | Narragansett Pier..... | 8.14 | 1883 |
| Do..... | Do..... | 9.40 | 1883 | S. Carolina..... | Charaw..... | 10.11 | 1887 |
| Do..... | McLeansborough..... | 9.28 | 1883 | Do..... | Charleston..... | 14.32 | 1876 |
| Do..... | Greenville..... | 9.52 | 1883 | Tennessee..... | Memphis..... | 8.56 | 1883 |
| Indiana..... | Indianapolis..... | 8.56 | 1883 | Texas..... | Brownsville..... | 15.71 | 1884 |
| Indian Ter..... | Fort Gibson..... | 8.30 | 1877 | Do..... | Do..... | 16.27 | 1887 |
| Iowa..... | Keokuk..... | 8.01 | 1881 | Do..... | Galveston..... | 17.78 | 1871 |
| Kansas..... | Atchison..... | 9.20 | 1870 | Do..... | Do..... | 17.39 | 1877 |
| Kentucky..... | Louisville..... | 8.05 | 1883 | Do..... | Do..... | 10.83 | 1881 |
| Louisiana..... | Shreveport..... | 9.30 | 1877 | Do..... | Palestine..... | 9.96 | 1882 |
| Do..... | Point Pleasant..... | 13.04 | 1880 | Do..... | New Ulm..... | 11.31 | 1877 |
| Do..... | Do..... | 13.69 | 1881 | Do..... | Do..... | 12.44 | 1881 |
| Maine..... | Gardiner..... | 13.15 | 1885 | Utah..... | Salt Lake City..... | 3.27 | 1876 |
| Do..... | Do..... | 12.67 | 1869 | Vermont..... | Croftsbury..... | 10.72 | 1869 |
| Maryland..... | Woodstock..... | 8.23 | 1885 | Virginia..... | Norfolk..... | 11.36 | 1872 |
| Massachusetts..... | Worcester..... | 9.81 | 1869 | Do..... | Variety Mills..... | 10.76 | 1885 |
| Michigan..... | Alpena..... | 13.18 | 1877 | Washington T..... | Tatoosh Island..... | 9.03 | 1884 |
| Do..... | Do..... | 10.25 | 1881 | Do..... | Do..... | 11.83 | 1887 |
| Minnesota..... | Saint Vincent..... | 6.61 | 1878 | Do..... | Neah Bay..... | 14.84 | 1887 |
| Mississippi..... | Natchez..... | 12.43 | 1877 | W. Virginia..... | Helvetia..... | 5.80 | 1885 |
| Do..... | Vicksburg..... | 9.69 | 1881 | Wisconsin..... | Madison..... | 9.12 | 1881 |
| Do..... | Hanlehurst..... | 10.20 | 1887 | Wyoming..... | Fort Laramie..... | 3.14 | 1874 |
| Missouri..... | Saint Louis..... | 7.51 | 1885 | | | | |

It has also been found from examination of records that rains of 2.50 inches and upwards in twenty-four hours in the month of October during any year since the commencement of reports have fallen as follows:

At various points in New England, especially in the coast regions, at Mount Washington, and in and near the Connecticut Valley; in the middle Atlantic states adjacent to the coasts, in the valleys, along the rivers, and on the western shore of Chesapeake Bay; on the coasts of the south Atlantic states, near the rivers and in adjacent valleys, on the mountain slope in western North Carolina, and in southwestern Georgia; in northern and eastern Florida and at Key West; in the Gulf States, especially on the coasts, and in Louisiana, also in numerous places inland on and adjacent to rivers; near the mouth of the Rio Grande; on the Pacific coast northward of the fortieth parallel; inland at points on or near the Mississippi River, from Memphis, Tenn., northward to the southern border of Wisconsin; in the Ohio Valley and Tennes-

see, especially adjacent to rivers; along and near the western tributaries of the Mississippi east of the one hundredth meridian, and from the west Gulf states northward to Omaha, Nebr.; in the valley of the Red River of the North; at Chicago, Ill., and in southern Michigan peninsula; on the southwestern shore of Lake Erie, and at Buffalo, N. Y.; also at three stations near the one hundred and fifth meridian, viz., Deadwood, Dak., Pike's Peak, Colo., and Fort Davis, Tex.

The following table shows the amount of excessive rainfall, at the rate of one inch or more per hour, during the month of October at any station during the years stated:

| Year. | State. | Place. | Date. | Duration. | | Total amount. | Rate per hour. |
|-------|----------|---------------|-------|-----------|----------|---------------|----------------|
| | | | | Hours. | Minutes. | | |
| 1880. | Illinois | Springfield | 25 | 0 | 06 | 0.23 | 2.30 |
| | Nebraska | Howard | 13 | 0 | 50 | 1.35 | 1.37 |
| 1881. | Texas | Brackettville | 3 | 8 | 00 | 1.80 | 5.40 |
| | Kansas | Fort Scott | 3 | 0 | 20 | 1.20 | 1.80 |
| | Indiana | Vevay | 4 | 0 | 40 | 2.25 | 1.28 |
| | Illinois | Swanwick | 6 | 1 | 45 | 1.50 | 0.98 |
| 1882. | Missouri | Pro Tem | 3 | 1 | 35 | 1.70 | 1.45 |
| | Texas | San Antonio | 8 | 1 | 10 | 5.20 | 1.04 |
| | Alabama | Mobile | 31 | 5 | 00 | 2.50 | 2.30 |
| 1883. | Kansas | Holton | 1 | 1 | 05 | 3.92 | 1.22 |
| 1887. | Florida | Titusville | 19-20 | 3 | 12 | 3.39 | 0.90 |
| | Texas | Abilene | 7-8 | 3 | 39 | | |

Table of excessive and greatest monthly precipitation for October, 1887.

| Station. | Specially heavy. | | | Largest monthly. | Station. | Specially heavy. | | | Largest monthly. |
|--------------------------|------------------|---------|-----------|------------------|------------------------|------------------|---------|-----------|------------------|
| | Date. | Amount. | Duration. | | | Date. | Amount. | Duration. | |
| <i>Alabama.</i> | | | | | <i>Louisiana—Con.</i> | | | | |
| Marion | 17 to 19 | 5.24 | | 7.70 | Coushatta | 24, 25 | 3.05 | | |
| Livingston | 17 to 19 | 4.62 | | | Monroe | 24 | 2.50 | | |
| Mount Vernon | 19 | 3.92 | | | New Orleans | 18, 19 | 3.19 | 13 00 | |
| Decatur | 17 to 18 | 2.09 | | | Shreveport | 24 | 2.92 | 23 30 | |
| Greenville | 19 | 3.00 | | | <i>Michigan.</i> | | | | |
| Opelika | 19, 20 | 3.05 | | | Gaylord | 3, 4 | 2.30 | | 6.88 |
| Mobile | 19, 20 | 3.08 | 13 15 | | Do | 33, 34 | 3.00 | | |
| Tusculum | 24 | 3.00 | | | Sault St. Mary | | | | 6.81 |
| Valley Head | 23 | 3.00 | | | Harrisville | 23 | 3.14 | 7 00 | |
| Gadsden | 20 | 2.50 | | | <i>Mississippi.</i> | | | | |
| Florence | 25 | 4.00 | | | Natchez | 17 to 19 | 10.43 | | 12.43 |
| Demopolis | 19 | 2.00 | | | Hazelhurst | 17, 18 | 10.00 | | 10.20 |
| Bermuda | 19 | 3.09 | | | Lake | 17 to 19 | 6.86 | | 6.86 |
| Owichee | 24 | 2.00 | | | Okolona | 24, 25 | 2.75 | | |
| <i>Arkansas.</i> | | | | | Batesville | 24 | 2.31 | | |
| Fort Smith | 9 | 2.70 | | | Meridian | 17 to 19 | 3.70 | | |
| British Columbia. | | | | | Waynesborough | 17 to 19 | 2.56 | | |
| New Westminster | 27, 28 | 3.66 | | 6.09 | Macon | 17 to 19 | 2.98 | | |
| <i>Florida.</i> | | | | | Brookhaven | 17 to 19 | 4.20 | | |
| Titusville | 19, 20 | 3.99 | 3 12 | 12.17 | Edwards | 17 to 19 | 3.27 | | |
| Key West | | | | 9.49 | Univ'ry of Miss | 24 | 2.67 | 19 00 | |
| Merritt's Island | | | | 8.19 | <i>New Jersey.</i> | | | | |
| Alva | 18, 19, 20 | 3.25 | | 6.00 | Egg Harbor City | 20, 21 | 2.22 | 3 50 | |
| Pensacola | 23 | 2.32 | 8 00 | | Roseland | 20 | 2.35 | | |
| Saint Augustine | 23 | 3.20 | | | Atlantic City | 20, 21 | 3.32 | 16 40 | |
| <i>Georgia.</i> | | | | | Bordentown | 21 | 2.00 | | |
| Millen | 20 | 3.15 | | 8.70 | Hopewell | 21 | 2.00 | | |
| Do | 26 to 28 | 6.00 | | | Imlaystown | 21 | 2.05 | | |
| Bainbridge Isl'nd. | 27, 28 | 6.00 | | 7.32 | Lakewood | 21 | 2.90 | | |
| Camak | | | | 6.34 | Oceanic | 21 | 3.52 | | |
| Augusta | | | | 6.38 | Toms River | 21 | 2.45 | | |
| Smithville | 20 | 3.50 | | 6.20 | <i>New York.</i> | | | | |
| Do | 26, 27 | 3.00 | | | Boyd's Corners | 20, 21 | 2.12 | | |
| Forayth | 19, 20 | 2.05 | | | <i>North Carolina.</i> | | | | |
| Milledgeville | 19, 20 | 2.05 | | | Salisbury | 18 to 20 | 4.28 | | 14.19 |
| Macon | 23 to 27 | 3.25 | | | Do | 24 to 30 | 9.84 | | |
| Albany | 20 | 3.00 | | | Chapel Hill | 18 to 20 | 2.86 | 33 00 | 11.21 |
| Do | 27 | 3.00 | | | Do | 24 to 31 | 8.20 | 172 15 | |
| Alapaha | 27 to 29 | 3.31 | | | Hatteras | 30, 31 | 3.94 | 16 45 | 11.07 |
| Fort Gaines | 19, 20 | 3.00 | | | Raleigh | 31 | 4.18 | 24 00 | 10.23 |
| Thomasville | 28, 29 | 3.90 | | | Weldon | 30, 31 | 3.47 | 13 55 | 9.97 |
| Union Point | 26 | 4.00 | | | Raleigh | 31 | 2.90 | | 9.80 |
| Waynesborough | 26 to 28 | 3.00 | | | Lumberton | 18 to 20 | 5.10 | | 9.31 |
| <i>Indian Territory.</i> | | | | | Do | 26 to 28 | 3.13 | | |
| Fort Bill | 7, 8 | 4.14 | 23 35 | 6.20 | Do | 18 to 20 | 3.45 | | 8.45 |
| Fort Reno | 7, 8 | 5.65 | 25 00 | 6.01 | Do | 24 to 31 | 5.18 | | |
| Eufaula | 9, 10 | 2.45 | | | Charlotte | 30, 31 | 3.49 | 24 00 | 8.04 |
| <i>Kansas.</i> | | | | | Wadesborough | 18 to 20 | 3.09 | | 6.64 |
| Wellington | 7, 8 | 6.03 | 8 00 | 6.06 | Do | 30, 31 | 3.35 | | |
| Globe | 7 to 9 | 3.32 | | | Wilmington | | | | 6.53 |
| Lebo | 8 | 3.30 | | | Stateville | 30, 31 | 2.07 | 12 30 | 6.51 |
| Tuopeka | 8 | 3.92 | | | Charleston | 25 | 3.15 | | |
| Independence | 7, 8 | 3.24 | 33 00 | | Goldsborough | 31 | 3.75 | | |
| <i>Louisiana.</i> | | | | | <i>Pennsylvania.</i> | | | | |
| Amite City | 19 | 3.65 | | | Fallingston | 20 | 3.33 | | |
| Port Gibson | 18 | 3.99 | | | Corry | 4, 5 | 2.31 | | |
| Natchitoches | 24, 25 | 4.00 | | | <i>South Carolina.</i> | | | | |
| Minden | 24 | 3.48 | | | Cheraw | 18 to 21 | 4.00 | | 10.11 |
| Lafayette | 18, 19 | 4.13 | | | Do | 25 to 31 | 6.11 | | |

Table of excessive and greatest monthly precipitation—Continued.

| Station. | Specially heavy. | | | Largest monthly. | Station. | Specially heavy. | | | Largest monthly. |
|-------------------------|------------------|---------|-----------|------------------|--------------------|------------------|---------|-----------|------------------|
| | Date. | Amount. | Duration. | | | Date. | Amount. | Duration. | |
| <i>S. Carolina—Con.</i> | | | | | <i>Texas—Con.</i> | | | | |
| Blackville | 30 | 2.34 | | 8.61 | Sour Lake | 18 | 2.40 | | |
| Do | 26 | 2.25 | | | Longview | 24 | 2.60 | | |
| Stateburg | 17, 18 | 2.50 | 16 30 | 8.15 | Huntsville | 24 | 2.05 | | |
| Florence | 18 to 20 | 4.22 | | 8.09 | Do | 24 | 2.00 | | |
| Columbia | 17, 18 | 2.77 | 13 53 | 7.43 | Corsicana | 24 | 2.50 | | |
| Kirkwood | 17 | 2.54 | | 7.23 | Brenham | 24 | 2.75 | | |
| Allendale | 20 | 3.35 | | 6.76 | Abilene | 7, 8 | 2.39 | 24 00 | |
| Do | 26 to 28 | 2.99 | | | Palestine | 24 | 2.60 | 15 38 | |
| Batesburg | 26 to 28 | 3.31 | | 6.51 | <i>Virginia.</i> | | | | |
| Saint Matthew's | 20 | 2.68 | | 6.28 | Fort Monroe | 29 to 31 | 3.36 | | 8.11 |
| Branchville | 27 | 2.00 | | | Cape Henry | 31 | 2.00 | | 6.43 |
| <i>Tennessee.</i> | | | | | Norfolk | | | | 6.38 |
| Grand Junction | 24, 25 | 2.07 | | | Bird's Nest | | | | 6.35 |
| <i>Texas.</i> | | | | | Rappahannock | 3 | 2.42 | 10 05 | 6.22 |
| Brownsville | 10, 11 | 6.00 | 13 24 | 16.27 | <i>Washington.</i> | | | | |
| Austin | 8, 9 | 2.78 | | | Neah Bay | 27 | 5.77 | 24 00 | 14.84 |
| Orange | 26, 27 | 3.99 | | | Tatoosh Island | 27, 28 | 4.59 | 20 00 | 11.83 |
| Weatherford | 8, 9 | 3.08 | | | Pysht | 26, 27 | 2.33 | | |

* Less than twenty-four hours.

DROUGHT.

For the purpose of showing the excess or deficiency of rainfall for the first ten months of the year in the various districts of the country, the following table has been prepared:

Precipitation for January to October—Signal Service observations.

| Districts. | Normal. | Average for 1887. | Comparison of 1887 with the normal. | Percentage of normal rainfall for the months of 1887. |
|-------------------------------|---------|-------------------|-------------------------------------|---|
| | Inches. | Inches. | Inches. | Per cent. |
| New England | 39.73 | 35.10 | - 4.63 | 96 |
| Middle Atlantic states | 36.62 | 35.59 | - 1.03 | 100 |
| South Atlantic states | 48.83 | 42.63 | - 6.20 | 87 |
| Florida Peninsula | 45.22 | 39.55 | - 5.67 | 87 |
| East Gulf states | 50.54 | 43.62 | - 6.92 | 86 |
| West Gulf states | 38.45 | 28.79 | - 9.66 | 75 |
| Lower Rio Grande valley | 25.18 | 39.62 | + 14.44 | 157 |
| Ohio Valley and Tennessee | 38.41 | 36.36 | - 2.05 | 95 |
| Upper lake region | 31.15 | 25.63 | - 5.52 | 83 |
| Extreme northwest | 29.86 | 22.78 | - 7.08 | 76 |
| Upper Mississippi valley | 17.96 | 16.61 | - 1.35 | 92 |
| Missouri Valley | 33.17 | 33.15 | - 0.02 | 99 |
| Northern slope | 27.03 | 23.10 | - 3.92 | 86 |
| Middle slope | 16.95 | 18.68 | + 1.73 | 110 |
| Southern slope | 19.57 | 19.70 | + 0.13 | 101 |
| Middle plateau | 20.57 | 21.62 | + 1.05 | 105 |
| Southern plateau | 10.58 | 11.13 | + 0.55 | 105 |
| Middle Pacific coast region | 10.96 | 8.61 | - 2.35 | 79 |
| Northern Pacific coast region | 13.76 | 12.71 | - 1.05 | 92 |
| Middle Pacific coast region | 35.85 | 42.47 | + 6.62 | 118 |
| South Pacific coast region | 16.81 | 11.76 | - 5.05 | 70 |
| | 8.75 | 7.68 | - 1.07 | 88 |

From the above table it will be seen that east of the Rocky Mountains the greatest percentage of deficiency in the rainfall for the first ten months of the year occurs in the upper Mississippi valley—the west Gulf states and upper lake region following next in order. In the lower Rio Grande valley more than double the average is shown.

The very serious drought which prevailed from May to September in Michigan, Wisconsin, Iowa, Ohio, Indiana, Illinois, Kentucky, and Missouri was slightly ameliorated in northern Wisconsin during October, but the condition of affairs at the end of the month was still serious, as appears from extracts elsewhere. The commencement of this drought was in April last, during which month less than 50 per cent. of the average precipitation fell in southern Michigan and Wisconsin, northern Illinois, the southwestern part of Iowa, and the northwestern part of Missouri.

During May a precipitation slightly above the average fell over a belt of country about sixty miles wide, extending from Cincinnati, Ohio, and Frankfort, Ky., westward to Indiana and Illinois, including the immediate valley of the Mississippi River as far as Jefferson City; elsewhere in the states previously named, the precipitation was largely deficient, especially in Iowa, Illinois, and the northern half of Michigan, where the percentage ranged from 20 to 50 of the average rainfall.

In June the area over which less than half the usual rain fell comprised Iowa, Illinois, southern Wisconsin, southwestern Michigan, and northwestern Indiana. Throughout the section named only from one-tenth to one-fifth of the usual rainfall for June occurred in many places.

During July a slight excess of rainfall fell over the northern half of the lower peninsula of Michigan and central Wisconsin, but throughout the rest of the drought-stricken states, the precipitation generally ranged from 50 to 80 per cent. of the average, except in Ohio, southern Indiana, southeastern Illi-

nois, and the western parts of Iowa and Missouri, where the amount of rain in some cases was only from 15 to 30 per cent. of the mean.

During August slight excesses fell in western Iowa, western Wisconsin, and the northern part of Illinois: throughout the rest of the drought district the rainfall was generally from one-half to three-fourths of the average, but in the greater part of Michigan, as well as in the southern part of Illinois, the amount was less than one-half the mean.

In September the greater part of Iowa, Wisconsin, and northern Illinois, and the extreme southern part of Michigan, was relieved by rainfall slightly in excess of the average, but the remaining states still suffered from a deficiency for the month, which in the northern part of Michigan ranged from one-sixth to one-half the usual amount.

The condition of affairs has improved materially in Wisconsin during October, where a slight excess of precipitation has fallen. In Michigan, Iowa, the greater part of Illinois, and Indiana the drought is aggravated, as the precipitation has only been from one-third to three-fourths of the usual amount, while in the valley of the Ohio and of the Mississippi, from Cairo to Quincy, the amount of rainfall has been exceedingly small, not averaging more than 20 per cent. for that district, and ranging from 10 to 30 per cent.

During the six months from May to October, inclusive, the rainfall has been largely deficient over Minnesota, Wisconsin, Michigan, Iowa, Missouri, Indiana, Illinois, Kentucky, and parts of Minnesota and Dakota, and eastern Nebraska and southeastern Kansas. Less than one-half the usual amount of rainfall during these months has fallen in central Ohio and at certain points on the immediate banks of the Ohio River, from Louisville to Cairo, inclusive. Similar local deficiencies, averaging more than 50 per cent., occurred near Springfield, Ill., Webster, Dak., and La Crosse, Wis. Less than three-fourths of the average amount of rain has fallen during these five months from Michigan, Ohio, and Kentucky westward to include Missouri and Iowa.

The percentages of rainfall which have occurred at different points are shown in the following tables:

Table showing distribution of precipitation during drought of 1887. The values are in percentages of the average rainfall for each month and for the entire period from May to October, inclusive.

| Station. | May. | June. | July. | Aug. | Sept. | Oct. | For six months |
|--------------------------|------|-------|-------|------|-------|------|----------------|
| <i>Ohio.</i> | | | | | | | |
| Cleveland..... | 109 | 60 | 25 | 107 | 96 | 63 | 74 |
| Sandusky..... | 50 | 95 | 18 | 43 | 70 | 34 | 54 |
| Columbus..... | 61 | 70 | 42 | 61 | 56 | 10 | 52 |
| Cincinnati..... | 101 | 59 | 35 | 71 | 86 | 21 | 63 |
| Toledo..... | 44 | 91 | 90 | 62 | 119 | 66 | 79 |
| Jacksonburg..... | 62 | 70 | 15 | 50 | 57 | 16 | 45 |
| North Lewisburg..... | 116 | 66 | 44 | 83 | 65 | 20 | 68 |
| Portsmouth..... | 50 | 94 | 99 | 51 | 70 | 30 | 68 |
| Ruggles..... | 90 | 85 | 60 | 129 | 60 | 30 | 66 |
| Wauseon..... | 162 | 83 | 71 | 50 | 71 | 62 | 87 |
| Westerville..... | 52 | 74 | | | | | |
| Marietta..... | 75 | 112 | 25 | 65 | 74 | | |
| <i>Indiana.</i> | | | | | | | |
| Indianapolis..... | 58 | 47 | 28 | 90 | 72 | 18 | 51 |
| Laconia..... | 57 | 71 | 17 | 24 | 81 | 12 | 47 |
| Lafayette..... | 41 | 35 | 25 | 109 | | | |
| Logansport..... | 81 | 76 | 64 | 100 | 81 | 70 | 80 |
| Vevay..... | 116 | 39 | 56 | 62 | 99 | 25 | 65 |
| <i>Michigan.</i> | | | | | | | |
| Port Huron..... | 70 | 68 | 53 | 68 | 95 | 48 | 66 |
| Detroit..... | 61 | 113 | 33 | 80 | 158 | 58 | 83 |
| Alpena..... | 73 | 59 | 150 | 31 | 49 | 88 | 74 |
| Mackinaw..... | 67 | 50 | 86 | 12 | 79 | 58 | 59 |
| Grand Haven..... | 88 | 13 | 92 | 61 | 102 | 72 | 74 |
| Escanaba..... | 21 | 52 | 125 | 36 | 28 | 82 | 55 |
| Marquette..... | 38 | 79 | 87 | 93 | 24 | 67 | 62 |
| Brady, Fort..... | 41 | 60 | 188 | 25 | 41 | 107 | 73 |
| Lansing..... | 50 | 27 | 46 | 25 | 176 | 60 | 59 |
| Traverse City..... | 25 | 120 | 84 | 40 | 17 | 99 | 63 |
| <i>Illinois.</i> | | | | | | | |
| Chicago..... | 40 | 41 | 30 | 100 | 130 | 59 | 64 |
| Cairo..... | 35 | 53 | 38 | 41 | 63 | 13 | 41 |
| Springfield..... | 41 | 54 | 48 | 37 | 70 | 22 | 47 |
| Aurora..... | 67 | 16 | 72 | 101 | 155 | 84 | 80 |
| Collinsville..... | 170 | 39 | 106 | 38 | 60 | 18 | 62 |
| Golconda..... | 50 | | | | | | |
| Greenville..... | | 42 | 29 | 57 | 148 | 16 | 55 |
| Griggsville..... | | | 47 | 32 | 81 | 21 | |
| McLeansborough..... | 73 | 64 | 150 | 24 | 121 | 12 | |
| Marengo..... | 77 | 30 | 139 | 5 | 44 | 18 | 57 |
| Mattoon..... | 29 | 30 | 79 | 134 | 120 | 106 | 82 |
| Palatine..... | 99 | 19 | 45 | 89 | 95 | 126 | 79 |
| Pana..... | 124 | 26 | 40 | 83 | 65 | 27 | 63 |
| Peoria..... | 155 | 31 | 67 | 125 | 106 | 30 | 83 |
| Rockford..... | 33 | 38 | 73 | 86 | 73 | 60 | 62 |
| Sandwich..... | 55 | 20 | 77 | 141 | 139 | 66 | 76 |
| Sycamore..... | 48 | 42 | 131 | 116 | 113 | 88 | 87 |
| <i>Kentucky.</i> | | | | | | | |
| Louisville..... | 55 | 42 | 46 | 78 | 98 | 13 | 54 |
| Frankfort..... | 110 | 56 | 97 | 95 | 149 | 28 | 89 |
| <i>Missouri.</i> | | | | | | | |
| Saint Louis..... | 130 | 51 | 71 | 47 | 71 | 27 | 64 |
| Lamar..... | 71 | 151 | 125 | 76 | 52 | 100 | 91 |
| <i>Kansas.</i> | | | | | | | |
| Leavenworth..... | 63 | 96 | 30 | 205 | 159 | 115 | 100 |
| Dodge City..... | 93 | 124 | 30 | 72 | 11 | 40 | 71 |
| Concordia (2 years)..... | 138 | 125 | 66 | 149 | 99 | 61 | 110 |
| Hays, Fort..... | 94 | 127 | 26 | 160 | 125 | 155 | 103 |
| Independence..... | 84 | 73 | 78 | 116 | 106 | 84 | 89 |
| Riley, Fort..... | 103 | 90 | 60 | 193 | 170 | 114 | 115 |
| Salina..... | 98 | 117 | 42 | 204 | 209 | 28 | 101 |
| Wellington..... | 63 | 52 | 52 | 211 | 58 | 29 | 73 |
| Yate's Centre..... | 49 | 107 | 99 | 99 | 90 | 49 | 80 |
| Manhattan..... | 60 | 111 | 24 | 199 | 194 | 124 | 109 |
| Lawrence..... | 24 | | | 174 | 170 | 124 | |

Table showing distribution of precipitation during drought, etc.—Continued.

| Station. | May. | June. | July. | Aug. | Sept. | Oct. | For six months |
|---------------------------|------|-------|-------|------|-------|------|----------------|
| <i>Nebraska.</i> | | | | | | | |
| Omaha..... | 29 | 75 | 36 | 111 | 69 | 25 | 57 |
| North Platte..... | 27 | 92 | 109 | 175 | 313 | 13 | 122 |
| Crete..... | 143 | 106 | 42 | 166 | 131 | 37 | 100 |
| Valentine (2 years)..... | 89 | 127 | 111 | 122 | 86 | 97 | 108 |
| De Soto..... | 34 | 110 | 27 | 94 | 78 | 64 | 67 |
| Fremont..... | 63 | 49 | 72 | 194 | 98 | 31 | 81 |
| Niobrara..... | 64 | 79 | 101 | 187 | 11 | 768 | 170 |
| Robinson, Fort..... | 143 | 30 | 101 | 187 | 11 | 768 | 170 |
| Genoa..... | 39 | 140 | 125 | 206 | 398 | | |
| <i>Iowa.</i> | | | | | | | |
| Davenport..... | 43 | 38 | 87 | 78 | 159 | 109 | 82 |
| Dubuque..... | 66 | 26 | 50 | 120 | 155 | 71 | 81 |
| Keokuk..... | 64 | 30 | 38 | 74 | 86 | 58 | 56 |
| Des Moines..... | 46 | 34 | 53 | 76 | 132 | 34 | 59 |
| Cresco..... | 26 | 41 | 67 | 77 | 176 | 60 | 77 |
| Independence..... | 26 | 38 | 84 | 74 | 253 | 39 | 91 |
| Logan..... | 30 | 54 | 45 | 124 | 114 | 38 | 66 |
| Muscatine..... | 50 | 48 | 71 | 52 | 90 | 70 | 63 |
| <i>Wisconsin.</i> | | | | | | | |
| Milwaukee..... | 55 | 21 | 156 | 74 | 138 | 89 | 86 |
| La Crosse..... | 17 | 23 | 37 | 63 | 88 | 66 | 47 |
| Beloit..... | 30 | 11 | 45 | 163 | 162 | 76 | 79 |
| Embarras..... | 70 | 100 | 99 | 132 | 127 | 120 | 112 |
| Madison..... | 63 | 32 | 118 | 106 | 156 | 98 | 98 |
| Manitowish..... | 43 | 34 | 50 | 78 | 163 | 123 | 78 |
| Wausau..... | 97 | 42 | | | | | |
| <i>Minnesota.</i> | | | | | | | |
| Duluth..... | 129 | 52 | 107 | 46 | 61 | 113 | 82 |
| Saint Paul..... | 49 | 60 | 118 | 92 | 126 | 73 | 86 |
| Moorhead..... | 87 | 86 | 132 | 46 | 14 | 54 | 79 |
| Saint Vincent..... | 148 | 148 | 148 | 66 | 31 | 7 | 94 |
| Minneapolis..... | 77 | 70 | 119 | 111 | 113 | 116 | 98 |
| Snelling, Fort..... | 65 | 132 | 99 | 155 | 97 | 73 | 107 |
| <i>Dakota.</i> | | | | | | | |
| Yankton..... | 30 | 53 | 131 | 142 | 211 | 46 | 100 |
| Huron..... | 42 | 97 | 112 | 163 | 9 | 46 | 95 |
| Bismarck..... | 77 | 27 | 183 | 64 | 108 | 97 | 57 |
| Sully, Fort..... | 52 | 83 | 119 | 151 | 33 | 121 | 94 |
| Deadwood..... | 91 | 58 | 147 | 147 | 184 | 132 | 110 |
| Buford, Fort..... | 84 | 111 | 88 | 268 | 142 | 144 | 128 |
| Fort Abraham Lincoln..... | 47 | 34 | 225 | 33 | 146 | 44 | 80 |
| Meade, Fort..... | 65 | 67 | 269 | 235 | 379 | 49 | 129 |
| Pembina..... | 56 | 195 | 143 | 38 | 38 | 12 | 58 |
| Randall, Fort..... | 11 | 27 | 113 | 132 | 99 | 27 | 34 |
| Richardton..... | 113 | 54 | | 83 | | 126 | |
| Sisseton, Fort..... | 60 | 187 | 176 | 284 | 70 | 52 | 154 |
| Webster..... | 28 | 43 | 73 | 90 | 25 | 29 | 46 |
| Yates, Fort..... | 182 | 48 | 109 | 74 | 366 | 190 | 119 |
| Totten, Fort..... | 87 | 156 | 122 | 104 | 81 | 105 | 119 |

Unless an excess of rainfall occurs during November these states must suffer owing to the small amount of water which fell during the first of the season, as streams and wells must fail and the ground itself be in such a dry condition as to interfere more or less materially with the winter wheat of the early spring crops.

The following notes on drought have been received:

Wash Woods, N. C., 9th: rain is much needed in this locality; wells are drying up, cisterns have long been exhausted, and cattle are suffering for water. There is a great deal of sickness prevailing in this locality, which is attributed to the long and severe drought. Rain amounting to one-half inch fell on the 10th.

University of Virginia, Va., 14th: weather very dry and many cisterns exhausted, but the season is favorable for cotton harvest. The first rain of the month fell on the 17th.

Huntington, Huntington Co., Ind., 15th: a severe drought is prevailing in this locality; farmers are compelled to go great distances for water both for cattle and domestic use.

Parkston, Hutchinson Co., Dak., 31st: the precipitation of the month, 0.15, is unusually small, and the ground is very dry.

Mottville, Saint Joseph Co., Mich., 31st: streams and wells continue low, not sufficient rain to be of benefit.

Fayette, Howard Co., Mo., 31st: the water in creeks and ponds is very low, and if rain does not fall before the winter sets in water for stock will be scarce in many places.

Charleston, Coles Co., Ill., 31st: creeks are all dry, and stock is suffering for water.

Cairo, Ill., 31st: the total precipitation for the month, 0.38, is the least amount recorded in October since the establishment of the Signal Service station in 1871; the fall sown cereals and late crops are suffering in consequence.

Garrettsville, Portage Co., Ohio, 31st: most of the brooks and swamps are dry and water in wells is at a lower stage than at any previous time this year.

Elyria, Lorain Co., Ohio, 31st: the severe drought which has prevailed in this section since last June still continues, and its effects are becoming more alarming. Streams all dry,

many wells have failed, and farmers have to haul water for stock.

Ruggles, Ashland Co., Ohio, 31st: very dry and water scarce.

Tiffin, Seneca Co., 31st: water has become scarce in this section of the state as a result of the continued dry weather.

West Milton, Miami Co., Ohio, 31st: on account of the long continued drought there is in some localities a great scarcity of water; wheat is suffering in consequence of drought.

Strafford, Orange Co., Vt., 31st: springs are low and fall pasturage has suffered in consequence of the dry weather.

The October report of the "Indiana Weather Service" states:

The total deficiency in precipitation during the month was 2.74 inches and since January 1, 1887, 13.21 inches. So great a deficiency, extending over so many months preceding October, surpasses any former droughts on record. From every part of the state, especially from the southern and central sections, reports have been received as to scarcity of water, and the evils consequent on such protracted drought are felt in many localities. Creeks and surface wells have become dry; wheat either has not come up at all or has turned yellow in many fields, and cattle are suffering from want of water, which has to be brought to many farms from great distances. The observer at Vevay reports that the Ohio River has been lower than noted for many years.

SLEET.

Sleet fell at scattering stations, mostly in the Northern States and territories, during the month on the following dates: 1st, 7th, 10th to 12th, 14th, 20th to 25th, 29th, 30th.

SNOW.

Reports show that snow fell in some part of the country on every day during the month, with the exception of the 1st, 2d,

and 27th. The snowfalls were, in general, light and, in many instances, local. From the 20th to 25th snow was of more general occurrence than during any other period of the month; on the 21st, 22d, and 23d it was reported from nearly all stations in the Lake region, and at many in the extreme northwest, New England, and the middle Atlantic states.

MONTHLY SNOWFALLS (in inches and tenths).

The following stations report monthly snowfalls of one inch or more:

Colorado.—Denver, 3.1. Dakota.—Deadwood, 13.1; Fort Buford, 11.5; Richardson, 2.8; Fort Totten, 1. Iowa.—Bancroft, 5. Michigan.—Marquette, 10.8; Alpena, Escanaba, and Harrisville, 1.5. Minnesota.—Minneapolis, 2. Montana.—Fort Maginnis, 20.2; Helena, 8.3; Poplar River, 7.8; Fort Custer, 1.1. Nebraska.—Hay Springs, 3; Valentine, 1.7; North Platte, 1.1. North Carolina.—Marion, 2. Ohio.—Garrettsville, 2.5; Cleveland, 1.4. Pennsylvania.—Erie, 3.5; Corry, 3; Washingtonville, 2; Wellsborough, 1.1. Utah.—Frisco, 4.2. Virginia.—Marion, 5 to 6; Wytheville, 1. Wisconsin.—Green Bay, 10.1; La Crosse, 2.5. Wyoming.—Cheyenne, 4.5; Fort Bridger, 2.

The only station reporting snow on the ground at end of month is Marquette, Mich.; depth, one inch.

HAIL.

Hail is reported to have fallen in various parts of the country from the 2d to 5th, 10th, 11th, 13th to 21st, 23d to 25th, 29th to 31st; it was most numerous reported on the 11th and from the 21st to 25th.

WINDS.

The most frequent directions of the wind during October, 1887, are shown on chart ii, by arrows flying with the wind. In the northern districts from the Rocky Mountains eastward to the Atlantic coast the prevailing winds are generally from southwest, west, or northwest; in the Southern States, northwest, north, or northeast; in the Rocky Mountain and Pacific coast districts, variable.

HIGH WINDS (in miles per hour).

The maximum velocities of the wind for October, 1887, at Signal Service stations where the movements are registered, are given in the table of miscellaneous meteorological data. But one station reports a velocity exceeding 50 miles per hour other than the maximum for the month, viz., Buffalo, N. Y., 60 miles, sw., on the 3d and 4th.

LOCAL STORMS.

La Crosse, Wis.: a severe thunder-storm occurred at this place from 12 to 1 a. m. on the 7th; hail, accompanied by light rain, fell for about twenty minutes, the hail-stones were quite large, some measuring two by one and one-half inches, but most of them were of the size of marbles.

Wellington, Sumner Co., Kans.: unusually heavy showers prevailed from 2.30 p. m. on the 7th until 10.30 a. m. on the 8th, 6.02 inches of rain having fallen in twenty hours. Much benefit has been derived from this rain; the fall-sown wheat was placed in good condition.

Key West, Fla.: a gale prevailed from 9.45 a. m. until 3 p. m. on the 8th, reaching a maximum velocity of thirty miles per hour at 12.25 p. m., and continuing at that rate until 1 p. m. Heavy rain fell from between 7 and 8 p. m. until after midnight, flooding the streets.

Riverside, San Bernardino Co., Cal.: on the 11th, at 12.45 p. m., a rain storm, accompanied by hail and light thunder. At 12.40 p. m. clouds from two directions appeared to meet in the southeast with a loud, rushing noise, similar to the approach of

a tornado. The track of the storm was about four miles wide, coming from the southeast, although the track of the heaviest hail was not more than a mile in width. The hail-stones were from an inch and a quarter in diameter down.

New Orleans, La.: a wind storm began 9.52 p. m. on the 11th and ended 9.04 a. m. the following day; maximum velocity, thirty miles per hour, from the north.

Brownsville, Tex.: fresh to brisk northerly winds and heavy rain began during early a. m. and ended 11.20 a. m. on the 11th, 5.60 inches of rain falling during the storm. The Rio Grande River overflowed, but fell rapidly during the 12th. Heavy rain began 1.45 p. m. on the 21st, changing to light rain 3.50 p. m. and ending 9.10 p. m. The rain during the first two hours was very heavy, 2.48 inches having fallen from 1.45 to 3 p. m.; the streets were flooded to a considerable extent.

Wood's Holl, Mass.: a storm began 10.40 a. m. and ended 12.40 p. m. on the 13th; maximum velocity, forty-two miles, from the southwest, occurred 2.55 p. m.

Titusville, Fla.: light and heavy rains prevailed during the 16th; total precipitation 3.33 inches; the rain was accompanied by high winds, reaching a velocity of thirty-eight miles per hour. The railroad bridge over Deep Creek, about twenty miles northeast of this place, was seriously damaged by the flood which resulted from the heavy rain, and the railroad track near the bridge was washed out about one-half mile.

Galveston, Tex.: a gale began 4.20 a. m. on the 18th, reaching a velocity of forty-eight miles per hour at 5 p. m.

Valentine, Nebr.: a gale began 8.35 a. m. on the 19th and continued until 6.40 p. m. on the 20th; maximum wind-velocity, fifty-four miles per hour from the north, occurred on the 19th.

WATER-SPOUT.

Capt. A. McDougall, of the s. s. "Caspian," reports: "October 6th, in N. 39° 32', W. 69° 10', at 10.35 a. m., wind n. by w., force 6, barometer 29.80; vivid lightning to se. and nw., with very loud peals of thunder; a very black squall made up

to the nw., with centre bearing nw. by w.; lightning disappeared from se., and squall passed rapidly to sw., at the same time raising a column of water about seventy feet high; could clearly observe water rushing down centre of spout and plough-

ing up the surface of the sea quite forty-five or fifty feet above level of the ocean. This was the largest water-spout I or other members of the crew ever saw. Wind kept steady in direction, but increased to force 7; barometer not affected."

COTTON REGION REPORTS.

In the following table are given the means of the maximum and minimum temperatures, and the average rainfall for the cotton-belt districts during the month. For the purpose of comparison the means for October of the five preceding years are also given.

Except in the districts of Memphis, Little Rock, and Galveston, the rainfall was largely in excess of the average; it was more than double the average in the districts of New Orleans, Savannah, Montgomery, and Mobile; for the Wilmington district it was more than four times the average, and for the Augusta district nearly three times the average. Marked deficiencies occurred in the districts of Little Rock and Memphis.

The means of the maximum and minimum temperatures were generally decidedly below the average for all districts, the departures exceeding 4° in the districts of Wilmington, Atlanta, Montgomery, Mobile, and New Orleans.

Temperature and rainfall data for the cotton districts, October.

| Districts. | Rainfall. | | | Temperature. | | | | | | | | Extremes for Oct., 1887. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| | Average for Oct. of five preceding years. | Average for Oct., 1887. | Departures. | Maximum. | | | | Minimum. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | Mean for Oct. of five preceding years. | Mean for Oct., 1887. | Departures. | Mean for Oct. of five preceding years. | Mean for Oct., 1887. | Departures. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| | Inch. | Inch. | Inch. | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | 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° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | °</ |

*Average for four years only.

INLAND NAVIGATION.

In the following table are shown the danger-points at the various river stations and the highest and lowest depths for October, 1887, with the dates of occurrence, and the monthly ranges:

Heights of rivers above low-water mark, October, 1887 (in feet and tenths).

| Stations. | Danger-point on gauge. | Highest water. | | Lowest water. | | Monthly range. |
|---------------------------|------------------------|----------------|---------|----------------------|---------|----------------|
| | | Date. | Height. | Date. | Height. | |
| Red River: | | | | | | |
| Shreveport, La.... | 29.9 | 28, 29, 30 | 11.8 | 4, 2 | 1.4 | 7.6 |
| Arkansas River: | | | | | | |
| Fort Smith, Ark.... | 22.0 | 13 | 9.4 | 4, 5, 6 | 0.7 | 8.7 |
| Little Rock, Ark.... | 23.0 | 16 | 8.5 | 9, 10, 11 | 1.6 | 6.9 |
| Missouri River: | | | | | | |
| Omaha, Nebr..... | 18.0 | 1 | 7.2 | 20, 25-31 | 5.7 | 1.5 |
| Leavenworth, Kans | 20.0 | 1 | 8.3 | 24 | 6.6 | 1.7 |
| Mississippi River: | | | | | | |
| Saint Paul, Minn.... | 14.5 | 9, 13, 17, 24 | 2.0 | 2, 3, 26-28 | 1.7 | 0.3 |
| La Crosse, Wis.... | 24.0 | 21-26 | 3.4 | 29-31 | 2.9 | 0.5 |
| Dubuque, Iowa.... | 16.0 | 25, 26 | 3.7 | 3, 4, 9-13 | 3.3 | 0.4 |
| Davenport, Iowa.... | 15.0 | 1-9 | 2.5 | 11-20, 22, 23, 27-31 | 2.3 | 0.2 |
| Keokuk, Iowa..... | 14.0 | 1 | 2.6 | 21, 22, 25-27, 29-31 | 1.9 | 0.7 |
| Saint Louis, Mo.... | 32.0 | 1 | 8.5 | 27, 30, 31 | 5.7 | 2.8 |
| Cairo, Ill..... | 40.0 | 1, 2 | 5.2 | 27 | 2.4 | 2.8 |
| Memphis, Tenn.... | 34.0 | 1 | 5.4 | 29-31 | 2.8 | 2.6 |
| Vicksburg, Miss.... | 41.0 | 1 | 2.8 | 31 | 1.8 | 4.6 |
| New Orleans, La.... | 13.0 | 16 | 4.2 | 31 | 1.9 | 2.3 |
| Ohio River: | | | | | | |
| Pittsburg, Pa..... | 22.0 | 10, 26 | 6.1 | 24, 25 | 5.7 | 0.4 |
| Cincinnati, Ohio.... | 50.0 | 7 | 4.9 | 18-20, 25, 26 | 2.8 | 3.1 |
| Louisville, Ky..... | 25.0 | 1, 9 | 2.6 | 14 | 1.9 | 0.7 |
| Cumberland River: | | | | | | |
| Nashville, Tenn.... | 40.0 | 4 | 1.9 | 19-23 | 0.2 | 3.1 |
| Tennessee River: | | | | | | |
| Chattanooga, Tenn. | 33.0 | 28 | 4.7 | 15-17 | 1.2 | 3.5 |
| Monongahela River: | | | | | | |
| Pittsburg, Pa..... | 29.0 | 10, 26 | 6.1 | 24-25 | 5.7 | 0.4 |
| Savannah River: | | | | | | |
| Augusta, Ga..... | 32.0 | 28 | 12.0 | 16 | 5.7 | 6.3 |
| Sacramento River: | | | | | | |
| Red Bluff, Cal..... | | 11-18 | 0.6 | 1-10, 19-31 | 0.5 | 0.1 |
| Sacramento, Cal.... | | 1-31 | 7.2 | 1-31 | 7.2 | 0.0 |
| Willamette River: | | | | | | |
| Portland, Oregon.... | | 1 | 3.5 | 25 | 0.0 | 3.5 |

STAGE OF WATER IN RIVERS AND HARBORS.

Toledo, Ohio: navigation on the Maumee River was suspended on account of low water on the 3d. The high wind

which prevailed during the night of the 2-3d drove the water out of the river into the lake, leaving several vessels aground. At Perrysburg, about ten miles southwest of Toledo, the Maumee River was lower than has been known for many years, a large part of the river bed being completely bare.

Cairo, Ill.: owing to the low stage of water in the Ohio River on the 12th the steamer "Gus Fowler" ran aground near Mound City. On the 27th the river reached the lowest stage since January, 1887. The Illinois Central Railroad company was compelled to extend its cradles farther into the river to enable the transfer steamers to reach them. The low water in both the Mississippi and Ohio rivers has caused a practical suspension of navigation, resulting in great inconvenience and heavy losses.

ICE IN RIVERS AND HARBORS.

Moorhead, Minn.: the Red River of the North froze the 24th.

Fort Buford, Dak.: the Missouri River froze over during the night of the 24-25th, ice forming to a thickness of two inches. On the 26th the ice broke up and passed down. The river was very low during the greater part of the month.

Cedar Rapids, Linn Co., Iowa: for the first time in October for many years Cedar River froze over, on the 25th.

HIGH TIDES.

Jacksonville, Fla.: the tide was unusually high at the mouth of the Saint John's River on the 15th.

Atlantic City, N. J.: during the morning of the 18th the tide was very high and caused some damage to the board walks; the beach was washed away in some places.

Wellfleet, Mass.: the highest tide ever known in this vicinity occurred on the 21st; the lower streets of this place were flooded.

The voluntary observer at Taunton, Mass., states that during the week ending October 23d the tides were unusually high.

The Signal Service observer at Kitty Hawk, N. C., reports high tides on the 30th and 31st.

ATMOSPHERIC ELECTRICITY.

AURORAS.

Auroras were observed during the month as follows: 2d, Poplar River, Mont. 5th, Poplar River, Mont. 8th, Eastport and Orono, Me. 10th, Fort Buford, Dak.; Saint Vincent, Minn.; Poplar River, Mont. 12th, Fort Buford, Dak.; Eastport, Me.; Poplar River, Mont. 13th, Fort Totten and Webster, Dak.; Moorhead and Saint Vincent, Minn.; Poplar River, Mont.; Fort Laramie, Wyo. 17th, Webster, Dak. 20th, Richardton, Dak. 21st, Duluth and Moorhead, Minn. 22d, Cornish, Me.; Alpena, Mich.; Moorhead and Saint Vincent, Minn.; Ardenia, N. Y.; Garrettsville, Ohio; Spokane Falls, Wash. 24th, Cornish, Me.

Of the above displays, the most brilliant were those observed during the night of the 21st-22d at Duluth and Moorhead, Minn., where the aurora appeared in the form of a bright arch, with shooting beams, reaching nearly to the zenith.

THUNDER-STORMS.

Thunder-storms are reported in the various states as follows:

1st, Lead Hill, Ark.; New London, Conn.; Cairo, Ill.; Dudley, Mass.; Nashua, N. H.; Setauket, N. Y.; Hatteras, N. C.; Jacksonborough, Ohio; Yaquima Light House, Oregon; Milan, Tenn. 2d, Lead Hill, Ark.; New Haven and New London, Conn.; Webster, Dak.; Archer, Fla.; Cairo, Charleston, Chicago, and Springfield, Ill.; Indianapolis, Logansport, and Terre Haute, Ind.; Cedar Rapids, Clinton, Cresco, Davenport, Independence, and Monticello, Iowa; Frankfort, Ky.; Portland, Me.; Amherst, Blue Hill Observatory, Deerfield, New Bedford, Somerset, Taunton, and Westborough, Mass.; Kalamazoo, Lansing, and Mottville, Mich.; Saint Paul, Minn.; Lamar, Mo.; Setauket, N. Y.; Wellsborough, Pa.; Embarras, Fond du Lac, and Manitowoc, Wis. 3d, Archer and Key West, Fla.; New Bedford, Mass.; Berlin Mills and Manchester, N. H.; Atlantic City, N. J.; Humphrey, Oswego, Palmyra, and Rochester, N. Y.; Cincinnati and Yellow Springs, Ohio; Parkersburg, W. Va. 4th, Voluntown, Conn.; Portland, Me.; Blue Hill Observatory, Dudley, Fall River, Somerset, Taunton, and Westborough,

Mass.; Berlin Mills and Nashua, N. H.; Buffalo and Le Roy, N. Y.; Cleveland, Ohio; Manchester and Strafford, Vt. 5th, Sandwich, Ill.; Albia, Cedar Rapids, Clinton, Independence, Monticello, and Mount Vernon, Iowa; Grand Haven, Mich.; DeSoto and Omaha, Nebr.; Beloit, Delavan, Embarras, Fond du Lac, Green Bay, La Crosse, Madison, Manitowoc, and Milwaukee, Wis. 6th, Charleston and Chicago, Ill.; Davenport, Cresco, Independence, and Keokuk, Iowa; Grand Haven, Lansing, Mottville, and Traverse City, Mich.; Fayette Mo.; Napoleon, Wausau, and Yellow Springs, Ohio; Yaquima Light House, Oregon; Delavan, Green Bay, La Crosse, Manitowoc, and Milwaukee, Wis. 7th, Las Animas, Colo.; Independence, Iowa; Grand Haven, Mottville, and Thornville, Mich.; Duluth, Moorhead, and Saint Paul, Minn.; Westtown, Pa.; Corpus Christi, Tex.; Port Angeles, Wash.; La Crosse, Madison, and Milwaukee, Wis. 8th, Tucson and Yuma, Ariz.; Salina and Wakefield, Kans.; Corpus Christi, Palestine, and San Antonio, Tex.; Fond du Lac, Wis. 9th, Lewis Creek, Cal.; Wakefield, Kans.; San Antonio, Tex. 10th, Tucson and Willcox, Ariz.; Galveston and New Ulm, Tex. 11th, Los Angeles and Riverside, Cal.; Cedar Keys and Limona, Fla.; Humphrey, N. Y. 12th, Cedar Keys and Limona, Fla. 13th, Willcox, Ariz.; Fort Lewis, Colo.; Cedar Keys, Fla.; Charleston, Ill.; Frisco, Utah. 14th, Key West, Fla.; Fort Union, N. Mex. 15th, Denver, Grand Junction, and Los Animas, Colo.; Fort Sully and Parkston, Dak.; Moorhead, Minn. 16th, Key West, Fla.; West Leavenworth, Kans.; Hiram, Ohio; Madison, Wis. 17th, Buffalo and Humphrey, N. Y.; Elyria and Garrettsville, Ohio. 18th, Tucson, Ariz. 19th, Fort Thomas, Ariz.; Merritt's Island, Fla. 20th, Buffalo and Fort Niagara, N. Y.; Corry, Meadville, and Pittsburg, Pa. 21st, Ardenia, Boyd's Corners, and Humphrey, N. Y. 22d, Salina, Kans.; Hudson, Mich. 23d, Clinton, Iowa; Globe, Lebo, and West Leavenworth, Kans.; Hudson, Mich. 24th, Corpus Christi, Palestine, and Rio Grande City, Tex. 25th, Fort Thomas, Ariz. 26th, Cedar Keys and Archer, Fla. 28th, Archer, Cedar Keys, and Duke, Fla. 29th, University of Virginia, Va. 31st, Chicomicomico, Hatteras, and Wash Woods, N. C.

MISCELLANEOUS PHENOMENA.

FOREST AND PRAIRIE FIRES.

Fort Bidwell, Cal.: fires were burning in the swamps three or four miles southwest of this place on the 4th.

Moorhead, Minn.: fires were burning in the prairies south of station during the afternoon and night of the 14th.

Saint Vincent, Minn.: fires were burning on the prairies near this place on the 15th. The air was full of smoke on the 18th.

Little Rock, Ark., 19th: forest fires were raging four miles northeast of this city. On the 21st the fires were still burning and were causing considerable damage.

San Diego, Cal.: brush fires prevailed north and northeast of this place on the 21st. Light smoke from fires burning in the mountains north and east of here overspreads this region.

Los Angeles, Cal., 22d: extensive fires have prevailed for several days past in the Santa Monica Mountain Range, destroying a considerable amount of timber; extensive fires are also reported in the San Bernardino Mountains. The 23d an extensive brush fire was burning on the hills east of this city.

Forest and prairie fires are also reported to have occurred as follows: Moorhead, Minn., 12th, 18th, 23d, 28th to 30th; Bismarck, Dak., 18th; Parkston, Dak., 20th; North Platte, Nebr., 19th, 28th; Little Rock, Ark., 22d, 23d.

METEORS.

Indianapolis, Ind.: an unusually bright meteor was observed at 9 p. m. on the 3d; it shot along a central arc of the sky, starting about 40° above the eastern horizon, moved a little

north of west, and disappeared when about half way between Ursa Minor and the zenith.

Moorestown, Burlington Co., N. J.: a meteor apparently three or four times the size of Venus was observed in the west-southwest at 6.30 p. m. on the 5th; when in altitude 40° it separated into two parts and disappeared when in altitude 35°.

Los Angeles, Cal.: a brilliant meteor is reported to have been observed about 7.10 p. m. on the 8th in the western sky; as it passed through the air it grew in size until it appeared to be about as large as the moon, when it suddenly burst in many pieces; its light when first seen was white and similar to that of an electric light, and when it burst the sky was illuminated as by an electric flash.

Dale Enterprise, Rockingham Co., Va.: a meteor, which illuminated the whole country, was observed at 9.40 p. m. on the 8th; it moved in a southeasterly direction, and after having passed a distance of twenty-four degrees it exploded.

Stateburg, Sumter Co., S. C.: a meteor was observed in the east at about 9.05 p. m. on the 12th; it moved from near the meridian eastward and downward, and disappeared about 10° south of Pleiades. In less than a minute another meteor, not so bright, appeared 8° or 10° north of the first, and pursued a parallel course; almost simultaneously with this latter meteor, and from nearly the same point in the heavens, a very small meteor shot off towards the North Star.

Mr. A. K. Holt, voluntary observer at Riverside, San Bernardino, Co., Cal., reports:

Shortly after midnight on the morning of October 18th, a most wonderful meteor was observed in the southwest. At first it was a bright ball of fire and increased in size and brilliancy with marvelous rapidity.

Oroville, Butte Co., Cal.: a meteor was observed at 4.55 a. m. on the 19th, passing in a direction from northwest to southeast; it was larger and more brilliant than the planet Venus; its flight was rapid, lasting eight seconds.

Keeler, Cal.: a meteor was observed at 7 a. m. on the 19th; it was first seen in altitude 48° and azimuth 135° , and last seen in altitude 40° and azimuth 100° . About three seconds previous to its disappearance it burst into six brightly colored balls, each of which was apparently about ten times the size of the meteor as first seen, and displayed red, violet, green, yellow, dark blue, and orange colors.

Abilene, Tex.: a very bright meteor was observed in the southwest at 6.34 p. m. on the 22d; it moved toward the north and exploded when to the northwest of station, the fragments flying in every direction.

Fort Maginnis, Mont.: a meteor apparently of unusual size passed in a direction from southeast to northwest at 11.20 p. m. on the 30th. On account of the light from the full moon the meteor did not appear very brilliant.

Meteors were also observed on the following dates:

3d, East Norway, Kans. 4th, Topeka, Kans. 6th, Archer and Key West, Fla.; Summit, Mass.; Rappahannock, Va.; Vashon, Wash. 7th, Woodstock, Md.; Clayton, N. J.; Cedar Springs, S. C.; Dale Enterprise, Va. 8th, Archer, Fla. 10th, Archer, Fla. 11th, Webster, Dak.; Woodstock, Md.; Cleburne, Tex.; Cheyenne, Wyo. 12th, Parkston, Dak.; Cleburne, Tex. 13th, Davenport, Iowa; Jacksonborough, Ohio; Dale Enterprise, Va. 14th, Nashua, N. H.; Dale Enterprise, Va. 15th, Somerset, Mass.; Nashua, N. H. 17th, Lead Hill, Ark.; Voluntown, Conn.; Beverly, N. J. 18th, Lead Hill, Ark.; Cahuenga, Cal.; Voluntown, Conn.; Vevay, Ind.; Nashua, N. H. 19th, Cahuenga and Los Angeles, Cal.; Woodstock, Md. 20th, Davenport, Iowa; Somerset, Mass.; Wytheville, Va. 21st, Archer and Manatee, Fla.; Statesville, S. C. 22d, Mount Angel, Oregon. 23d, Clayton, N. J.; Dale Enterprise, Va. 24th, Fort Sully, Dak.; Davenport, Iowa. 25th, Davenport, Iowa. 26th, Little Rock, Ark.; Elk Falls, Kans. 27th, Kalamazoo, Mich.; Cleburne, Tex. 30th, Davenport, Iowa. 31st, New Haven, Conn.; Manatee, Fla.; New Bedford, Mass.

MIGRATION OF BIRDS.

Geese flying southward.—Mobile, Ala., 8th; Fort Mojave, Ariz., 2d, 3d; Fort Bidwell, Cal., 11th, 23d, 25th; Sacramento, Cal., 7th, 10th to 12th, 15th, 19th, 20th, 28th, 31st; North Colebrook, Conn., 27th; Fort Buford, Dak., 20th, 21st; Fort Sully, Dak., 2d, 25th, 29th; Fort Meade, Dak., 4th, 6th; Washington City, 23d, 25th; Charleston, Ill., 21st; Laconia, Ind., 29th; Fort Reno, Ind. T., 14th; Fort Sill, Ind. T., 5th, 13th, 16th; Cedar Rapids, Iowa, 20th; Dodge City, Kans., 4th; Manhattan, Kans., 21st; Ninneseah, Kans., 16th, 17th, 28th; Wakefield, Kans., 3d; Yates Centre, Kans., 24th; Grand Haven, Mich., 28th, 29th; Harrisville, Mich., 13th, 24th, 25th; Lansing, Mich., 26th; Marquette, Mich., 21st; Mottville, Mich., 18th,

19th, 20th, 24th, 25th; Saint Louis, Mo., 23d; Fort Assinaboine, Mont., 9th; Fort Custer, Mont., 12th; Fort Maginnis, Mont., 26th; Crete, Nebr., 19th, 28th; Tecumseh, Nebr., 22d; Clayton, N. J., 26th; Moorestown and New Brunswick, N. J., 25th; Palmyra, N. Y., 24th, 27th; Factoryville, N. Y., 25th; Albany, Oregon, 12th, 13th, 21st, 22d, 31st; East Portland, Oregon, 6th; Linkville, Oregon, 3d, 7th, 12th to 14th, 17th, 22d, 27th, 29th, 30th; Dyberry, Pa., 25th; Ashwood, Tenn., 25th; Cleburne, Tex., 17th; Corsicana, Tex., 24th; Palestine, Tex., 24th to 25th; San Antonio, Tex., 17th; University of Virginia, Va., 1st; Rappahannock Va., 16th, 19th, 22d, 30th; Fort Canby, Wash., 21st; Green Bay, Wis., 2d.

Ducks flying south.—Fort Sully, Dak., 24th; Titusville, Fla., 26th, 28th; Cedar Rapids, Iowa, 20th; Monticello, Iowa, 4th; Wakefield, Kans., 26th; Yates Centre, Kans., 24th; Poplar River, Mont., 5th; Fort Assinaboine, Mont., 9th; Brownville, Nebr., 24th; Kitty Hawk, N. C., 25th, 26th; Tiffin, Ohio, 14th; Palestine, Tex., 4th, 25th, 26th; Silver Falls, Tex., 4th, 25th, 26th; Tatoosh Island, Wash., 2d to 7th, 9th.

Oranes flying south.—Fort Buford, Dak., 16th, 17th; Elk Falls, Kans., 20th; Wakefield, Kans., 13th; West Leavenworth, Kans., 25th, 26th, 28th to 30th; Yates Centre, Kans., 24th; Brownville, Nebr., 20th; Austin, Tenn., 5th; Corsicana, Tex., 13th; Rappahannock, Va., 31st.

Brants flying south.—Fort Madison, Iowa, 14th; West Leavenworth, Kans., 4th, 26th; East Portland, Oregon, 4th; Palestine, Tex., 24th.

MIRAGE.

Mirages were reported from the following places: Yuma, Ariz., 12th; Webster, Dak., 18th, 31st; Richardton, Dak., 27th; Salina, Kans., 4th, 5th, 9th, 21st, 22d, 25th, 26th; Marquette, Nebr., 3d, 16th, 17th, 18th; Galveston, Tex., 4th.

SAND STORMS.

Keeler, Cal.: a severe sand storm began 10.15 p. m. on the 6th, the wind reaching a maximum velocity of forty-two miles per hour at 10.25 p. m. The wind raised great clouds of sand which completely obscured the sky.

Los Angeles, Cal.: a severe sand storm occurred on the afternoon of the 7th, filling the air with dust and sand, and rendering travel difficult. The Sierra Madre range of mountains was obscured from view at the station. Maximum velocity of the wind, thirty-four miles per hour, at 2.30 p. m. The storm was general in this section and quite severe in the valleys, but no damage has been reported.

Fort Grant, Ariz.: a sand storm prevailed throughout the 10th; high easterly winds began 8.30 a. m. and continued, with increasing force, until midnight; maximum velocity, forty-eight miles per hour, from the east.

Sand storms also occurred at the following places: Fort Mojave, Ariz., 6th; Fresno, Cal., 6th, 7th, 11th; Keeler, Cal., 7th to 10th; Fort Thomas, Ariz., 11th; San Carlos, Cal., 11th, 29th.

SUN SPOTS.

Mr. H. D. Govey, of North Lewisburg, Champaign Co., Ohio, reports having observed sun spots on the following dates: 2d, 3d, 20th to 22d, 24th, 25th.

VERIFICATIONS.

INDICATIONS FOR 33 HOURS IN ADVANCE.

In view of the fact that the multiplication of districts has largely increased the work of the verifications officer so as to materially delay his reports, and also interfere with other special work devolving upon him, the Chief Signal Officer has decided that hereafter the percentage of successful predictions be based on one only of the tri-daily indications. Since the 10 p. m. indications is the the only one which includes predictions for the entire country, in connection with which the temperature and weather signals are displayed, the percentages will be calculated therefor. An additional reason for the selection of the 10 p. m. indications is the fact that an examination of

twelve consecutive months' percentages shows the average of the 10 p. m. indications to vary less than one-tenth of one per cent. from the general means. In order to make the data comparable, the official percentages for the current fiscal year have been recomputed, so as to show the detailed percentages with reference to the 10 p. m. indications.

The following paragraphs from Instructions No. 66, current series, are given in explanation of the method of verifying the indications:

In determining the percentage of verifications of predictions, the conditions occurring during the twenty-four hours predicted for, as shown by the charts for the 2d, 3d, and 4th reports following the report on which the prediction is

made, will be carefully examined by the verifying officer, who will ascertain the amounts, in tenths, to which the conditions predicted for each state or territory, or part of state or territory, have prevailed in it. The area for which the prediction is made will be considered in verifying weather and temperature. In giving weight to the three maps which are used in verifying the indications, a failure on the first map will lower the verifications four-tenths (.4), and on each of the succeeding maps three-tenths (.3), each. The barometer indications will not be verified, as the prediction is left optional with the Indications Officer.

In determining the percentage of verification of predictions of wind direction the verifying officer will note the direction reported on the three charts to which the prediction applies, and will ascertain whether the directions observed fulfill the predictions, as follows: If the direction predicted is observed at one-tenth of the observations reported from the stations on the three charts under consideration the percentage of verifications will be rated one (1); more than one-tenth and not more than two-tenths (.2), and so on up to ten.

In determining the total monthly percentages of verifications for all the predictions, the percentage of verification for each state for weather will be multiplied by five; for temperature, by four; and for wind direction, by one; and the sum of all these will be divided by ten.

In applying the foregoing rules, a prediction of fair weather will be construed to indicate an absence of rainfall.

When fair weather is predicted, it will be verified by consulting the three maps separately, and any precipitation (rain or snow) falling at a station on one map will reduce the percentage for the area in such proportion as has been described above; that is, failure on the first map is valued at four-tenths (.4), and on the other maps at three-tenths (.3) each.

The term, "local rains" or "local snows," will be construed to mean that rain or snow will fall, as shown on the three charts, at half the stations; but in verifying such prediction the three maps will be consulted as a whole, and proportionate reduction will be made for any rainfall or snowfall occurring at more than half the stations during the twenty-four hours. A proportionate reduction will be made when rain or snow falls at the same station at two different periods, except the rain is falling at the time of observation.

A simple temperature prediction of "higher," "lower," or "stationary," will be verified by the last map only. The term "stationary temperature" indicates a change of three degrees or less from May to August, inclusive; five degrees from November to February, inclusive; and four degrees for the remaining months. During the months when maxima and minima temperatures are received, these maps will, in case of cloudy weather, or rain or snow, be consulted in verifying periods which end at 7 a. m. or 3 p. m., respectively.

The prediction of north winds will include northwest, north, and northeast winds; the prediction of northeast winds will include north, northeast, and east winds; the prediction for east winds will include northeast, east, and southeast, and so on for the other quadrants.

Hereafter in making wind predictions, the Indications Officer will designate whether the force will be light, fresh, brisk, or high. A light wind will be one of eight (8) miles or under; a fresh wind, from six (6) to fourteen 14; a brisk wind, from twelve (12) to twenty-four (24); and a high wind, from twenty (20) miles upward.

In verifying the wind, equal weight will be given to direction and velocity.

These rules were followed in verifying the indications for September and October, 1887, and will be hereafter observed in verifications work. The percentages for July and August, as given in the accompanying table, will be taken as the official statement in place of the figures previously published in the REVIEW for those months:

Percentages of indications verified, July to October, 1887.

| States. | July. | August. | September. | October. |
|---------------------------|-------|---------|------------|----------|
| Maine..... | 57.80 | 73.66 | 69.11 | 75.35 |
| New Hampshire..... | 63.63 | 72.58 | 69.44 | 72.06 |
| Vermont..... | 63.98 | 74.46 | 73.89 | 77.39 |
| Massachusetts..... | 66.67 | 73.13 | 68.44 | 74.33 |
| Rhode Island..... | 77.15 | 69.09 | 68.99 | 71.35 |
| Connecticut..... | 70.70 | 69.63 | 68.43 | 73.10 |
| Eastern New York..... | 61.56 | 71.77 | 68.23 | 71.10 |
| Western New York..... | 63.71 | 67.30 | 72.23 | 76.74 |
| Eastern Pennsylvania..... | 67.74 | 66.67 | 80.13 | 77.10 |
| Western Pennsylvania..... | 56.06 | 73.66 | 72.11 | 80.90 |
| New Jersey..... | 70.97 | 71.24 | 73.36 | 76.55 |
| Delaware..... | 73.19 | 68.83 | 74.44 | 77.68 |
| Maryland..... | 65.05 | 65.86 | 75.44 | 77.42 |
| District of Columbia..... | 66.13 | 63.17 | 74.56 | 74.26 |
| Virginia..... | 66.28 | 66.67 | 70.00 | 76.16 |
| North Carolina..... | 77.42 | 72.04 | 74.11 | 78.65 |
| South Carolina..... | 74.46 | 72.58 | 77.78 | 80.96 |
| Georgia..... | 73.12 | 76.08 | 69.33 | 76.71 |
| Eastern Florida..... | 73.39 | 74.19 | 77.86 | 71.16 |
| Western Florida..... | 74.73 | 66.13 | 77.54 | 65.42 |
| Alabama..... | 70.97 | 71.02 | 69.07 | 77.90 |
| Mississippi..... | 68.52 | 70.34 | 73.90 | 70.23 |
| Louisiana..... | 73.58 | 75.00 | 77.53 | 73.52 |
| Eastern Texas..... | 85.75 | 83.87 | 73.79 | 72.58 |
| Arkansas..... | 70.16 | 79.84 | 78.50 | 76.13 |
| Tennessee..... | 67.30 | 73.39 | 64.56 | 78.42 |
| Kentucky..... | 70.16 | 75.81 | 65.00 | 81.29 |
| Ohio..... | 73.83 | 77.15 | 68.33 | 78.84 |
| West Virginia..... | 79.03 | 73.39 | 72.47 | 81.19 |
| Indiana..... | 71.51 | 73.31 | 67.78 | 82.48 |

Percentages of verifications verified, &c.—Continued.

| States. | July. | August. | September. | October. |
|---------------------------|-------|---------|------------|----------|
| Illinois..... | 72.31 | 68.49 | 65.56 | 79.97 |
| Lower Michigan..... | 75.54 | 73.39 | 68.44 | 73.51 |
| Upper Michigan..... | 59.95 | 65.32 | 68.22 | 74.64 |
| Wisconsin..... | 69.09 | 69.63 | 66.78 | 70.37 |
| Minnesota..... | 65.86 | 72.04 | 60.44 | 71.08 |
| Iowa..... | 65.86 | 70.70 | 67.79 | 79.84 |
| Kansas..... | 63.98 | 67.74 | 65.76 | 86.42 |
| Nebraska..... | 50.72 | 69.09 | 62.67 | 83.65 |
| Missouri..... | 72.04 | 71.51 | 65.11 | 79.45 |
| Colorado..... | 63.17 | 68.82 | 64.33 | 76.81 |
| Eastern Dakota..... | 50.72 | 65.65 | 62.00 | 77.64 |
| <i>By elements:</i> | | | | |
| Weather..... | 68.17 | 69.59 | 62.25 | 78.09 |
| Wind..... | 65.59 | 68.94 | 77.02 | 79.29 |
| Temperature..... | 72.20 | 75.62 | 71.11 | 73.71 |
| General average..... | 68.62 | 71.18 | 70.13 | 76.46 |
| <i>PACIFIC COAST:</i> | | | | |
| Southern California..... | 92.47 | ..... | 79.38 | 84.83 |
| Northern California..... | 91.13 | ..... | 79.60 | 83.67 |
| Oregon..... | 84.95 | ..... | 65.91 | 73.28 |
| Washington Territory..... | 77.90 | ..... | 63.18 | 69.63 |
| <i>By elements:</i> | | | | |
| Weather..... | 94.76 | ..... | 72.29 | 86.32 |
| Wind..... | 79.44 | ..... | 73.95 | 75.36 |
| Temperature..... | 85.68 | ..... | 69.69 | 68.51 |
| General average..... | 86.63 | ..... | 71.96 | 78.10 |

* No indications issued during the month of August.

NOTE.—Seven per cent. should be added to these verifications when compared with those for previous years, to represent the increased period for which they are made, 33 instead of 24 hours.

The predictions for all districts east of the Rocky Mountains for September, 1887, were made by 1st Lieutenant Robert Craig, 4th Artillery, Acting Signal Officer and Assistant; the verifications of temperature up to and including the 10 p. m. report of the 19th, and the wind force up to and including the 10 p. m. report of the 2d, were made by 2d Lieutenant F. M. M. Beall, Signal Corps, Assistant; the remaining verifications were determined by 2d Lieutenant John P. Finley, Signal Corps, Assistant.

The predictions during October were made by Junior Prof. H. A. Hazen; the verifications were determined by 1st Lieutenant Robert Craig, 4th Artillery, Acting Signal Officer and Assistant. Those for the Pacific coast during September and October were made by 2d Lieutenant J. E. Maxfield, Signal Corps, Assistant; the verifications for September were determined by 2d Lieutenant John P. Finley, Signal Corps, Assistant, and for October by 1st Lieutenant Robert Craig, 4th Artillery, Acting Signal Officer, Assistant.

CAUTIONARY SIGNALS, OCTOBER.

Of the total number of cautionary and storm signals ordered during October, 1887, it was practicable to determine the justification or failure of ninety-four, of which fifty-four, or 57.45 per cent., were fully justified. Of the above, eighteen were ordered for cautionary signals; number justified, nine, or 50.00 per cent. Seventy-six storm signals were ordered; number justified, forty-five, or 59.21 per cent. Total number of direction signals ordered, ninety-nine; justified, eighty-nine, or 89.90 per cent. Of these, thirty-six were ordered for easterly winds; justified, thirty-one, or 86.11 per cent. Number of signals ordered for westerly winds, sixty-three; justified, fifty-eight, or 92.06 per cent. Number of signals ordered late, i. e., after justifying velocity had begun, five.

In three instances winds were reported which would have justified the display of cautionary and storm signals, but for which no signals were ordered.

COLD-WAVE SIGNALS.

Total number of cold-wave signals ordered, the justifications of which were determined, ninety-five; number justified, thirty-one, or 32.63 per cent.

CAUTIONARY SIGNALS, SEPTEMBER.

Of the total number of cautionary and storm signals ordered during September, 1887, it was practicable to determine the justification or failure of forty-six, of which twenty-eight, or 60.87 per cent. were fully justified. Of the above, thirty-eight were ordered as cautionary signals; number justified, twenty-six,

or 68.42 per cent. Eight storm signals were ordered; number justified, two, or 25.00 per cent. Fifty-five direction signals were ordered; justified, fifty, or 90.91 per cent.; of these, twenty-eight signals were ordered for easterly winds; justified, twenty-four, or 85.71 per cent.; twenty-seven signals were ordered for westerly winds; number justified, twenty-six, or 96.30 per cent., and five storms occurred for which no signals were ordered. No signals were ordered late, i. e., after the verifying velocity had begun.

The following rules adopted for determining the justification or non-justification of signals are given:

The signals ordered will indicate the degree of the intensity of the storm and direction of the wind during the display. The degree of intensity will be indicated by two different signals, to be designated, respectively, the "cautionary signal" and the "storm signal," and the direction of the wind by four different signals, to be designated after the four quadrants, viz., "northeast," "southeast," "northwest," and "southwest."

The following are the wind directions which should occur at any station to justify the display of a direction signal. For signals for an easterly quadrant, winds from any direction from northeast to south, both inclusive. For signals for a westerly quadrant, winds from any direction from north to southwest, both inclusive.

The justification of wind signals will be determined by districts, all signals (one or more) displayed in one district at the same time counting as one signal.

Percentages of justifications will be computed separately for each of the following classes of signals, viz., cautionary signals; storm signals; signals for easterly winds; signals for westerly winds.

Cautionary and storm signals will be justified by the wind velocities occurring during the displays, according to the following rules:

A signal will be recorded as justified if the wind attain a justifying velocity at one or more stations in the district.

A direction signal will be recorded as justified if the direction indicated by the signal occurs, during the display, at one-half or more of the stations in the district.

The statement showing the percentages of signals justified, will also show the number of storms for which signals were not ordered and the number of signals ordered late.

A storm without signals will be recorded whenever a justifying velocity without signals is reported from two or more stations of the same or contiguous districts during a period of eight hours, or whenever said velocity, without signals, is reported from the same station once or more during each of two or more consecutive periods of eight hours.

When a signal is justified but the wind attains a justifying velocity before the signal is ordered, it will be recorded as late.

LOCAL VERIFICATIONS.

The following is from the report of the "Michigan State Weather Service" for October, 1887:

Weather and temperature signals are now displayed in one hundred and thirty-five towns in the state, and on the baggage-cars of twenty-five trains on seven principal railroads of the state.

The percentage of verification of weather signals for October is as follows (the verification is taken from reports of displaymen furnished this office monthly): temperature, 85.6 per cent.; weather, 85.2 per cent.; temperature and weather, 85.4 per cent.

The percentage of verification of weather predictions for October on the D., G. H., and M. R'y., is 87.3 for weather and 82.7 for temperature; on the C. & G. T. R'y., weather, 83.7, and temperature, 84.0; P. H. & N. R'y., weather, 86.3, and temperature, 83.7; M. C. R'y., for weather, 85.3, and for temperature, 84.0; G. R. & I. R'y., weather, 81.3, and temperature, 84.0; C. & W. M. R'y., weather, 83.0, and temperature, 82.7.

There was one cold-wave signal displayed on the 4th at 11 a. m., and lowered at 9 a. m. of the 5th. Four stations report the signal verified by a fall of 15° or more in the temperature.

The following is from the October, 1887, report of the "Minnesota Weather Service:—"

Verifications of weather signals for Minnesota were 83 per cent. for weather and 74 per cent. for temperature.

The following is from the "Tennessee State Board of Health Bulletin" for October, 1887:

The percentage of verification of weather and temperature predictions, furnished daily from the Signal Office at Washington to the various stations in the state during the month, was for the state: weather, 86.3 per cent.; and temperature, 86.2 per cent.

ERRATA.

September, 1887, REVIEW, page 240, in the table of the extreme monthly ranges of barometer, Rio Grande City, Tex., should read Brownsville, Tex.

In the table of "Miscellaneous meteorological data," page 262, the mean reduced barometer at Eastport, Me., 29.92, should read 30.01.

On page 253, under the heading of "Drought," Rappahannock, Caroline Co., 30th, should read Rappahannock, Fauquier Co.

In the table of "Meteorological record of voluntary observers and Army post surgeons," on page 264, the monthly mean temperature at Cedar Rapids, Iowa, 47.8, should read 63.2.

July, 1887, REVIEW, page 208, the departure from the normal precipitation, for the district of New England, -0.96, should read +0.96.

STATE WEATHER SERVICES.

The following extracts are republished from reports for October, 1887, of the directors of the various state weather services:

The "Alabama Weather Service," P. H. Mell, jr., of the Agricultural and Mechanical College, Auburn, director:

The first weeks of October were mild and pleasant weather, with but little rain in any part of the state. Heavy rains were produced on the 17th to 20th by the low pressure that prevailed at Mobile and along the Gulf during this period. Precipitations were quite frequent during the last two weeks of the month until the low pressure on the Gulf was forced out by the high pressure that swept across the country during the 25th, 26th, and 27th. This cyclonic disturbance was followed by a cold wave on the 29th and 30th of some severity. This cold wave produced a heavy frost throughout the state on the morning of the 31st. Ice was also formed at the same time. This was the first killing frost of the winter. Light frosts were reported on the 12th, but little damage was done. For the month of October the temperature was 5° 2 below the average, and the precipitation was 0.31 of an inch below the average.

Summary.

Temperature (in degrees Fahr.).—Monthly mean, 61° 9; highest monthly mean, 69° 3, at Pine Apple; lowest monthly mean, 46° 6, at Tusculumbia; maximum, 87° 2, at Mobile, on the 10th; minimum, 22°, at Gadsden, on the 31st; range for state, 65° 2; greatest monthly range, 61°, at Gadsden; least local monthly range, 42°, at Selma. Frosts, 12th to 15th, 22d and 31st.

Precipitation, including melted snow (in inches).—Average for the state, 2.85; greatest, 4.95, at Tusculumbia; least, 0.08, at Pine Apple.

Winds.—Prevailing direction, northeast.

The "Monthly Review of the Illinois Weather Service," Col. Charles F. Mills, director:

The temperature for the month was considerably below the normal in all parts of the state. The greatest departure was at Greenville, where it was 6° 8 below the normal of nine years. Other remarkable departures were at Golconda, 6° 4 below the normal of nine years; at Aurora, 6° 2 below the normal of nine years; at Sycamore, 6° 1 below the normal of seven years; at Springfield, 5° 9 below the normal of nine years, and at Chicago, where it was 5° 3 below the normal of sixteen years. In no part of the state did the temperature reach the normal for the month. The early part of the month was

warm for the season, but the latter was much colder than usual. The coldest day in the northern and central divisions was the 25th; the warmest for the state was the 7th. In the southern division, the coldest day was the 30th.

The average temperature for October was 50° 4, which is 3° 8 below the normal of the past thirteen years, and only once in that time has the October mean been lower, in 1875, when it was 49° 3, which was the coldest, while October, 1881, with a mean of 71° 2, was the warmest in the above period. The average temperature of the northern division was 46° 5; for the central, 51° 4, and for the southern, 53° 3. The highest mean temperature reported was 62° 3, at Benton, Franklin Co.; the lowest was 41° 9, at Prairieville, Lee Co. The highest temperature reported was 92°, at Oquawaka, Henderson Co., and the lowest, 12°, at Cedarville, Stephenson Co., giving an absolute range of 80°.

The remarkable drought of the season continued through the month unabated. In four places only in the state did it reach the normal, and, in most places, it was far below it. The 2d, 9th, 10th, and 23d were the days on which rain fell generally, especially in the northern and central divisions, the southern was far less fortunate all through the month, its deficiency being much greater than that of either of the other divisions. The northern division got most, the central next, and the southern least of all, the rainfall of the former being more than twice that of the latter. The greatest amount reported was 3.59 inches at Aurora, and the least was 0.30 of an inch at Jacksonville, Morgan Co. The average for the state was 1.49 inches, which was 2.04 inches below the normal of the last ten years.

The "Indiana Weather Service," Prof. H. A. Huston, of Purdue University, Lafayette, director:

The monthly mean barometric pressure over the state of Indiana during October was slightly above the normal pressure for a number of years. This was evidently caused not only because a greater number of high barometric areas in passing eastward brought their central pressure very near Indiana, but also because a smaller number of low barometric areas, when passing eastward, moved so far north or south from the state that only the isobars more distant from the centres of such low areas reached Indiana, or, only slight depressions or troughs, joining two low areas, in British America and over the Gulf of Mexico, respectively, affected the barometer slightly and for a short time only.

The mean temperature for October, 1887, was 4° below the normal; the weather was uniformly cool, the temperature being each day below the normal, except during the 6th and 9th, when it was above. The total deficiency was nearly 15° during the month, and since January 1, 1887, 35°; having started with 117° in excess on September 30, the month ended with a deficiency of 35°. Hoar frost occurred frequently in nearly every part of the state.

The precipitation was considerably below the normal, more especially in the central and southern parts. The total deficiency during the month was 2.74 inches, and since January 1, 1887, 13.21 inches. So great a deficiency, extending over so many months preceding October, surpasses any former droughts on record. From every part of the state reports have been received as to great scarcity of water, and the evils consequent on such protracted drought are felt in many localities. Creeks and surface wells have become dry; wheat either has not come up at all or has turned yellow in many fields, and cattle are suffering for the want of sufficient water, as it has to be brought to many farms from great distances. The observer at Vevay reports that the Ohio River has been lower than noted for many years.

Summary.

Atmospheric pressure (in inches).—Monthly mean, 30.139; maximum observed, 30.789, at Mount Vernon, on the 25th; minimum, 29.650, at Worthington; range for state, 0.802; greatest local range, 0.979, at Lafayette; least local range, 0.580, at Rockville.

Temperature (in degrees Fahr.).—Monthly mean, 49.6; highest monthly mean, 55.9, at Mount Vernon; lowest monthly mean, 43.0, at Mauzy; maximum, 86.0, at Vevay and Logansport, on the 7th; minimum, 14.0, at Mauzy, on the 22d; range for state, 72.0; greatest local monthly range, 64.0, at Mauzy and Logansport; least local monthly range, 47.0, at Rockville.

Precipitation, including melted snow (in inches).—Average for the state, 1.06; greatest, 2.22, at Angola; least, 0.27, at Brookville.

Wind.—Prevailing direction, southwest.

The "Kansas Weather Service," Prof. J. T. Lovewell, Topeka, director:

The mean temperature for the month is 54° 6; the highest temperature, 96°, occurred in the central counties on the 5th and 6th; the lowest temperature, 10°, occurred in Gove and Logan counties on the 24th, making the range of temperature for the state 86°; the mean temperature has ranged below the normal over the state.

The average precipitation for the state is 1.40 inches; the greatest, 4.81, occurring at Rome, Sumner Co., while at Grinnell and Kanapolis no precipitation occurred. A peculiar feature is that the temperature and rainfall are both below the normal. Nearly all of the precipitation fell during the storm of the 7-9th.

The "Michigan Crop Report" (the state weather service is in charge of N. B. Conger, Sergeant, Signal Corps, at Lansing):

The meteorological features of the state are based upon reports received from sixty-one voluntary observers and eight of the United States Signal Service. Ten of these reports are for rainfall only.

The temperature is below the normal in all sections for October, and the precipitation is above the normal in the northern half of the state and below the normal in the southern half. Two severe storms passed over the state, accompanied by high winds which did considerable damage to shipping, and several terrible disasters are recorded of vessels going down, with the loss of many lives.

Temperature.—The mean temperature for the state, 44° 1, is 5° 5 below the normal. The temperature for the sections is below the normal from 5° 7 in the Upper Peninsula to 8° 0 in the northern section. The highest mean daily temperature, 64°, occurred on the 8th, and the lowest, 21°, on the 25th. The temperature reached the maximum on the 8th, and then fell slowly until the 13th, then a rise on the 15th, then the temperature fell steadily until the minimum was reached on the 25th, when it again rose to the normal on the 31st. The highest temperature for the month, 85°, occurred on the 8th, and the minimum, 4° 0, on the 30th. Frosts were general throughout the state after the 11th.

Precipitation (in inches).—The average monthly precipitation, 3.16, is 0.40 below the normal. The deficiency is greatest in the central counties, where it amounts to 1.03. The Upper Peninsula and northern counties show an excess of 0.37 in the former, and 0.22 in the latter. General rains fell on the 1st, 2d, 3d, 4th, 9th, 10th, 11th, 20th, 21st, 22d, and 23d, and local precipitation on the 6th, 7th, 8th, 12th, 13th, 16th, 17th, 27th, 28th, and 29th. The rain on the 9th, and the rain and snow which occurred on the 23d, were heavy, the amounts at many stations being over one inch.

The average number of rainy days for the Upper Peninsula was 14.8; northern counties, 12.4; central counties, 8.9; southern counties, 9.2; for the state, 10.5.

Hail was reported from eleven stations.

Snow was general on the 21st to 24th, but it melted rapidly, and but a trace is reported on the ground at the end of the month. The exceptions are Calumet, 0.2 inch; Marquette, 1.0 inch; Gaylord and Sault Ste. Marie, 2 inches.

Summary.

Temperature (in degrees Fahr.).—Monthly mean, 44.1; highest monthly mean, 48.7, at Grand Rapids; lowest monthly mean, 38.0, at Calumet; maximum, 83.0, at Corunna, on the 8th; minimum, 4.0, at Gaylord, on the 30th; range for state, 79.6; greatest local monthly range, 71, at Gaylord; least local monthly range, 47.0, at Calumet; greatest daily range, 46.0, at Ewart, on the 16th; least daily range, 3.7, at Grand Haven, on the 1st.

Precipitation, including melted snow (in inches).—Average for the state, 3.16; greatest, 6.88, at Gaylord; least, 1.49, at Detroit.

Wind.—Prevailing direction, southwest.

The "Minnesota Weather Service," Prof. Wm. W. Payne, Carleton College, Northfield, director:

The month was characterized by a slight excess of precipitation over a small area in the northern portion of the state and a decided deficiency elsewhere. The first snow of the season was generally reported throughout the state during the month, and was quite heavy in some localities. The temperature was markedly below the normal, and during the passage of a severe cold wave on the 25th the minimum was below zero at some stations, this being the coldest weather experienced in October for many years. In some counties the ground was frozen to the depth of several inches and plunging was interrupted.

Temperature.—The mean for the state is 40° 3; this is respectively 2° 4 and 11° 1 below that of the corresponding months of 1885 and 1886; and is about the lowest recorded since 1873, when it was about the same. The month was one of comparatively low temperature throughout, at stations where records have been kept for years the means are considerably below the normal.

Precipitation.—This has been very unevenly distributed; the least amounts having fallen in the extreme northwestern portion of the state, while the greatest were in the north-central and northeastern portions, or in the region of the Great Woods, where it was slightly above the normal. The average for the state was 1.52 (inches); this is 0.60 above that of the corresponding month of 1885 and 0.10 above that of 1886. Although the average is above that for the preceding two Octobers, yet at stations where the normal is obtained from the observations of a number of years there is a decided deficiency.

Wind.—The prevailing direction was from the northwest.

The "Missouri Weather Service," Prof. Francis E. Nipher, of Washington University, Saint Louis, director:

Temperature.—The average temperature for the state was 52° 9. The highest monthly mean was 57° 1, at Pro Tem, Taney Co., and the lowest monthly mean, 45° 6, at Ironton, Iron Co. The highest temperature reported was 95° 0, at Pro Tem, on the 6th, and the lowest temperature, 18° 0, at Ironton, Iron Co., and Fayette, Howard Co., on the 30th. The total range in temperature for the state was 77° 0; the greatest local monthly range was 78° 5, at Fayette, and the least local monthly range was 45° 0, at Savannah, Mo.

Rainfall (in inches).—The average rainfall for the state was 1.65. Greatest rainfall, 3.87, at Leavenworth, Kans.; least, 0.38, at Cairo, Ill.

The "New England Meteorological Society," Prof. Wm. H. Niles, of the Institute of Technology, Boston, Massachusetts, president:

Reports for the month were received from one hundred and forty-seven observers.

Atmospheric pressure (in inches).—Monthly mean, 30.00 (twenty-one stations); maximum observed, 30.58, at Nashua, on the 26th; minimum observed, 29.23, at Eastport on the 21st; range for New England, 1.35; greatest local monthly range, 1.32, at Portland; least local monthly range, 0.98, at Middletown.

Temperature (in degrees Fahr.).—Monthly mean, 48.2 (one hundred and eight stations); highest monthly mean, 54.6, at Nantucket; lowest monthly mean, 40.7, at Mayfield; maximum, 80, at Taunton, on the 10th, and Olneyville on the 8th and 10th; minimum, 12, at West Milan, on the 16th; range for New England, 68; greatest local monthly range, 64, at Lake Cochituate; least local monthly range, 28, at Nantucket; greatest daily range, 52, at Berlin Mills, on the 16th; least daily range, 1, at Manchester, Mass., on the 2d and 30th.

Precipitation, including melted snow (in inches).—Average for New England, 2.49 (one hundred and thirty-one stations); greatest, 4.56, at Long Plain; least, 1.21, at North Conway and Chelsea.

Wind.—Prevailing directions, west and northwest.

The "New Jersey Weather Service," Prof. George H. Cook, of the Agricultural College, New Brunswick, director:

Temperature (in degrees Fahr.).—Monthly mean, 52.3; highest monthly mean, 58.9, at Ocean City; lowest monthly mean, 46.5, at Rancocas; maximum, 89.0, at Clayton, on the 8th; minimum, 21.0, at Hanover, on the 31st; range for state, 68.0; greatest local monthly range, 63.2, at Egg Harbor City; least local monthly range, 3.8, at Ocean City; greatest daily range, 44.0, at Locktown, on the 18th; least daily range, 5, on the 28th.

Precipitation, including melted snow (in inches).—Average for the state, 2.61; greatest, 5.00, at Ocean City; least, 1.58, at Princeton.

Wind.—Prevailing direction, northwest.

Summary.

Mean temperature, 52° 3; highest temperature, 79° 0, on the 8th; lowest temperature, 27° 4, on the 31st; monthly range of temperature, 51° 6; greatest daily range of temperature, 31° 8, on the 16th; least daily range of temperature, 3° 7, on the 1st; mean daily range of temperature, 18° 2. Total precipitation, 2.68 inches. Number of days on which .01 or more of precipitation fell, 10; number of clear days, 8; number of fair days, 14; number of cloudy days, 9. Light frost, occurred on the 12th and 14th; killing frosts occurred on the 13th, 15th, 16th, 23d, 26th.

The "Ohio Meteorological Bureau," Prof. B. F. Thomas, of the Ohio State University, Columbus, president:

Atmospheric pressure (in inches).—The mean atmospheric pressure for the month was 30.08, which is 0.03 below the mean for the past five years. The

highest reading of the barometer reported was 30.52, at Wauseon, on the 25th, and the lowest, 29.55, at Jefferson, on the 4th. The monthly range was 0.96.

Temperature.—The mean temperature was 49° 3, which is 3° 1 below the five years' average, 3° below the normal for the month, and is the lowest for the month of October since the opening of the bureau. The highest temperature was 89° 8, at Logan, on the 7th, and the lowest, 11° 5, at Waverly, on the 31st. The monthly range was 78° 3, which is 9° 2 below the mean range for the past five years.

Precipitation (in inches).—The most noticeable feature of the weather was the unusually small rainfall. The mean for the state was 0.75; this is 1.62 below the five-year average, and is less than one-third the normal amount. General, though light, rains occurred throughout the state on the 3d, 9th, 10th, 11th, 23d, and 29th, and in the northern section on the 1st, 2d, 4th, 5th, 21st and 22d. The greatest rainfall reported was 3.55, at Jefferson, and the least, 0.11, at Springborough. The drought which began in June continued throughout October, and as a consequence many of the small streams and wells have dried up, and the rivers are very low, causing serious interruption to business, many furnaces being closed for want of water. The low stage of the water has also caused much sickness, typhoid fever being prevalent in many parts of the state.

Average number of clear days, 12.2; average number of fair days, 9.0; average number of cloudy days, 9.8; average number of days on which rain or snow fell, 3.7; least number of days on which rain fell, 1, at New Bremen; greatest number of days on which rain fell, 14, at Cleveland (Hyde); mean monthly rainfall, 0.75; average daily rainfall, 0.24.

Prevailing direction of the wind, southwest.

"Oregon Weather Service," report prepared by B. S. Pague, Private, Signal Corps:

A marked feature of the month has been the abnormally high temperature which continued until the 23d in the northern and central parts of the state, and along the coast, but on the date mentioned the temperature fell decidedly; the first killing frosts of the season being reported on the 23d and 24th; in the extreme southern and in the eastern portion the temperature continued high until the 15th, when killing frosts were reported from those regions, it was again high from the 17th to 23d. The maximum temperature occurred from the 3d to the 12th, the minimum on 23d and 24th. An unusually warm wave was felt at Bandon, on Coos Bay, on the 11th; it was very warm throughout the state on that day, but especially so there; the temperature rose to 86°, a very unusual feature. The observer reports an easterly wind; temperature of 58° at 6 a. m., 74° at 9 a. m., 86° at 12 m., and 62° at 6 p. m. The mean of the state is 51° 3.

Precipitation, (in inches).—The most marked feature of the month has been the great deficiency in the rainfall in all sections. A few showers occurred, the greatest number, 13, at Astoria; the least, 1, at Lakeview. The greatest deficiency occurred at Bandon, where it was 3.36; the least, 0.66, at Fort Klamath. For the season, from July 1st, the precipitation is below the average in all sections of the state.

The "Pennsylvania State Weather Service," report prepared under the direction of the Franklin Institute, Philadelphia, by Sergeant T. F. Townsend, Signal Corps, assistant:

The general climate of the state for October has been from 2° to 5° colder than usual, especially in the western and elevated counties. The cold of the 15th, 22d, 26th, and 31st was quite general, and nearly all the western and northern counties report snow on the 21st and 22d, in amounts from "ground covered" to one inch at Scranton and Wellsborough, and four inches at Greenville. Most vegetation was cut off throughout the state by the killing frost of September 26th, although in some of the eastern and southern counties, and in the lower valleys, the harder sorts were continued until the severe frosts, which occurred during the latter half of October, and from which no district was free. An abundant growth of fall wheat and grass has been reported.

The colder belt of highlands had a mean of 45° at observing stations, and about 40° for the higher surfaces. The central counties had an average of 47° at observing stations, with a very considerable area of 50° in the valleys, and of 52° at West Chester, Swarthmore, Uniontown, Pottstown, and Carlisle, 53° at Pittsburg, and 55° 6 at Philadelphia, which is not a full degree below the average for a series of years. The mean at Erie was 48° 9, and therefore 4° 4 below the general mean of 53° 3.

The season at the lake shore was probably not so much extended as usual, owing to the severe frosts in September and October. None of these changes were either caused or attended by general storms of severity. The month was remarkably free from storms or floods, the rainfall being generally light. The southwestern part of the state is reported as very dry. In Westmoreland county the scarcity of water in wells and cisterns is causing much inconvenience. At several posts of observation, the rainfall was less than an inch, at Pittsburg, State College, Ridgway, McConnellsburg, Huntingdon, Indiana, Greenville, Washington, Greensburg, Catawissa, Charlesville, and Phillipsburg. Erie and Fallsington were exceptional, with 4.43 inches at Erie, and 3.06 at Fallsington. The number of rainy days varied from four to seventeen, the average for the state being seven. A severe wind storm from the southwest and west occurred at Greengburg, Greenville, Clarionville, Indiana, Meadville, and Scranton on the evening of the 23d. The general atmospheric movement for the month was rather less marked than usual, and no northeast storm occurred east of the Alleghanies, as often happens in October.

The "South Carolina Weather Service," Hon. A. P. Butler, Commissioner of Agriculture for South Carolina, director:

Temperature (in degrees Fahr.).—Monthly mean, 61.4; highest monthly mean, 66.3, at Yemassee; lowest monthly mean, 55.9, at Kirkwood; maximum, 91, at Spartanburg, on 11th; minimum, 30, at Chester, on the 31st; range for state, 61; greatest local monthly range, 56, at Chester, Kingstree, and Spartanburg; least local monthly range, 38, at Yemassee; greatest daily range, 41, at Yemassee, on the 7th; least daily range 3, on the 20th, at Beaver Mine.

Precipitation, including melted snow (in inches).—Average for the state, 5.96; greatest, 10.11, at Cheraw; least, 2.50, at Jacksonborough; average number of rainy days, 8.5.

Wind.—Prevailing direction, north.

The following is an extract from the report of the "Meteorological Department of the State (Tennessee) Board of Health," prepared under direction of J. D. Plunkett, M. D., President of the State Board of Health, by H. C. Bate, Signal Corps, Assistant, Nashville:

October was characterized by the large percentage of clear or fair weather and the almost total absence of electrical disturbances. The other features showed but slight departures from the normal. The cold wave which passed over the state on the 5th resulted in a light frost in the eastern and middle divisions. Altogether, the month was a delightful one.

The mean temperature was 55° 9, slightly below the normal October mean of the past five years. The maximum temperature observed was 90°, recorded on the 10th, and was the highest October maximum during the five years, except in 1884, when it reached 99°. The minimum temperature was 22°, recorded on the 31st, and was, together with the October minimum in 1884, the lowest in the above corresponding period. The monthly range of temperature was the greatest October range during the above period, except in 1884. There were three cold-wave predictions during the month, viz., 4-5th, 24-25th, and 29-30th, all of which were fully verified.

The mean precipitation for the month was 2.57 slightly below the normal of past five years. Of this amount the eastern division received an average of three and a quarter inches, the middle division two and a half inches, and the western division, two inches. The greatest rainfall was 5.60 inches, reported at Fostoria, and the least was 1.22 inches, reported at Milan. The greatest rainfall in twenty-four consecutive hours was 3.30 inches, reported at Fostoria, on the 19th. The first half of the month was almost rainless, slight showers being reported on the 1st, 10th, and 11th. From the 17th to the 25th, inclusive, nearly all the rain of the month was received, the rains of the 17th, 24th, and 25th being general, the others mostly local, and generally light. The heaviest rain of the month fell on the 24th. About fifteen days were without measurable rainfall. Frosts were reported on about ten days, several of these, notably on the 12th, 13th, 22d, and 31st, were killing frosts, the others mostly light. Dews were reported on about eight days. On the 30th there was a very slight fall of snow in the eastern and middle divisions; the greatest amount fell at Greenville, but at most of the other stations it was scarcely noticeable.

Prevailing wind, north.

NOTES AND EXTRACTS.

DIRECTION OF MOVEMENT OF AREAS OF LOW PRESSURE.

[By 2d Lieut. F. M. M. BEALL, Signal Corps, Assistant.]

An examination of the prevailing meteorological conditions in the vicinity of low areas will develop certain characteristics usually found with all areas of low pressure, such as a general movement of the air in the vicinity around, and inclined towards the centre of the low area; the highest temperature in the east or south quadrants and the lowest in the west or north; the presence of cloud and rain in certain portions of the area and fair weather in others, etc.

Now, if these characteristics are uniform attendants upon areas of low pressure, it will be practically an easy matter, in studying the tri-daily charts of the Weather Bureau, to draw conclusions in reference to the probable weather conditions at some future period, provided we are able to correctly define the paths the low areas will pursue.

The several forces which seem to influence the direction of movement of low areas in the United States appear to be:

- (1.) The general drift of the atmosphere.
- (2.) Unequal results of centrifugal force on all sides of the area.
- (3.) Unequal condensation of vapor at all points within the area.
- (4.) Unequal temperature changes in the vicinity of the area.
- (5.) Unequal pressure changes in the vicinity of the area.
- (6.) Attraction by neighboring areas of high barometer.
- (7.) Unknown influences.

(1.) Over the region of the United States the general drift of the atmosphere is toward the east, and any abnormal disturbance prevailing within its limits will be affected by this motion and eventually conform to its direction, although superior forces may often cause a low area to temporarily take an opposite course.

(2.) The circulation of the air around a low area, from right to left and inclined towards the centre, can be seen illustrated upon any weather chart having a well-defined area of low pressure. This circulation immediately becomes subject to centrifugal forces, and the tendency of the revolving air to fly away from the centre is apparent. On the east side of the low area the air passes over points of latitude having an easterly motion less than its own, which causes it to move to the right or east. On the west side the conditions are reversed and the air is thrown to the west, which is also to the right. That on the north and south sides is similarly deflected to the right. This deflecting force being greater on the north side than on the south, increasing as the sine of the latitude as we go northward, the greatest outward pressure will be on the north side, and the consequent tendency of the whole area to move in that direction. This deflecting force toward the north, taken in connection with the eastward drift, gives the area a direction between east and north.

(3.) The condensation of the cloud vapor about the low area, and the consequent liberation of latent heat, generates a force of importance. The liberated heat expands and increases the ascending capacity of the surrounding air, which rises and makes room for more. This permits the outside air to move in and supply the deficiency. The rate of condensation in the several parts of the low area varies. At the point where the greatest condensation takes place should be found the greatest inflow of air, on account of liberated heat. The centre of the low area and the point of greatest precipitation do not usually coincide, but as the condensation of vapor and expansion of the air cause a reduction in pressure at that point the area of low pressure will be influenced by the reduction and move in that direction, provided other and superior forces do not exercise greater influence. When the other forces are normal or coincide with that caused by vapor condensation the influence is very marked in cases of heavy precipitation.

(4.) In addition to the effect of temperature changes mentioned under (3), we will consider such other changes as may be due to direct heating of the air near the earth's surface from other causes than that of condensation of vapor. The cloud envelope which is usually found over and about a low area, shields

the earth from the direct rays of the sun during the day and retards radiation during the night. Around the margin of, and at broken places in, this envelope the sun will often raise the temperature decidedly above that in the immediate vicinity. This unequal temperature has a similar influence upon the low area as noted in (3), concerning similar conditions caused by the liberation of latent heat.

(5.) We have seen in (3) and (4) that the temperature of the air about a low area is increased at points in several ways, unless confined this temperature increase causes a decrease of pressure, also a cooling of the air in the rear quadrant of the low area is generally attended by an increase of pressure. Considering a low area as a mass of air out of equilibrium, with the greatest departure at the centre, and introducing these temperature disturbances of pressure we at once see that the points of pressure changes must exert an influence in disturbing the equilibrium. In the natural attempt to restore a mean pressure each disturbing factor exerts itself in proportion to its intensity, and we will find the direction of the low area affected accordingly.

(6.) The influence of a high area upon a low area in its vicinity is often quite noticeable and should be taken into consideration, especially if the gradient between them is more than a tenth of an inch to two hundred miles. The high area seems to have a slight attraction for the low, and the direction of the latter will often be slightly bended from its normal course. For instance, if the high area is south of the low the course of the latter will be more easterly, and if north of the low its course will be more northerly than its normal direction.

(7.) We sometimes find the low area will move in directions which the apparent forces do not justify. Such movements may be attributed either to influencing conditions prevailing beyond the field of observation, or to forces which available observations do not show.

It is not intended to convey the impression that these modifying influences of the movement of low areas are always apparent, but that one or more of them may be recognized upon any weather chart having a well-defined area of low pressure.

Record of temperature and precipitation at Wallingford Conn., from 1856 to 1887, inclusive, from observations made by B. F. Harrison and B. H. Catlin.

| Year. | January. | | February. | | March. | | April. | | May. | | June. | | July. | | August. | | September. | | October. | | November. | | December. | |
|-------|--------------------|----------------|--------------------|----------------|--------------------|----------------|--------------------|----------------|--------------------|----------------|--------------------|----------------|--------------------|----------------|--------------------|----------------|--------------------|----------------|--------------------|----------------|--------------------|----------------|--------------------|----------------|
| | Temperature (Fah.) | Precipitation. | Temperature (Fah.) | Precipitation. | Temperature (Fah.) | Precipitation. | Temperature (Fah.) | Precipitation. | Temperature (Fah.) | Precipitation. | Temperature (Fah.) | Precipitation. | Temperature (Fah.) | Precipitation. | Temperature (Fah.) | Precipitation. | Temperature (Fah.) | Precipitation. | Temperature (Fah.) | Precipitation. | Temperature (Fah.) | Precipitation. | Temperature (Fah.) | Precipitation. |
| | Mean | Inches. | Mean | Inches. | Mean | Inches. | Mean | Inches. | Mean | Inches. | Mean | Inches. | Mean | Inches. | Mean | Inches. | Mean | Inches. | Mean | Inches. | Mean | Inches. | Mean | Inches. |
| 1856 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |  |
| 1857 | ..... | 4.39 | ..... | 2.08 | ..... | 2.47 | ..... | 4.10 | ..... | 6.85 | ..... | 3.07 | ..... | 2.93 | ..... | 11.68 | ..... | 3.22 | ..... | 1.98 | ..... | 2.67 | ..... | 6.61 |
| 1858 | ..... | 4.39 | ..... | 2.08 | ..... | 2.47 | ..... | 7.11 | ..... | 7.76 | ..... | 3.23 | ..... | 2.29 | ..... | 5.62 | ..... | 3.17 | ..... | 5.88 | ..... | 2.06 | ..... | 5.79 |
| 1859 | ..... | 3.13 | ..... | 1.92 | ..... | 1.57 | ..... | 45.8 | ..... | 3.87 | ..... | 53.2 | ..... | 68.3 | ..... | 5.08 | ..... | 69.5 | ..... | 3.26 | ..... | 66.0 | ..... | 4.07 |
| 1860 | 25.4 | 6.94 | 29.0 | 4.24 | 39.8 | 8.24 | 44.6 | 3.76 | 58.0 | 4.73 | 63.3 | 6.25 | 68.1 | 2.58 | 67.6 | 6.12 | 58.7 | 5.18 | 52.8 | 3.29 | 34.5 | 3.23 | 28.3 | 4.47 |
| 1861 | 36.0 | 3.38 | 38.8 | 3.13 | 37.4 | 3.61 | 44.1 | 2.11 | 57.0 | 4.04 | 65.4 | 1.90 | 67.9 | 2.72 | 69.5 | 5.53 | 59.5 | 3.38 | 46.8 | 1.91 | 41.3 | 2.49 | 25.3 | 4.01 |
| 1862 | 37.7 | 4.07 | 53.0 | 3.90 | 34.2 | 3.03 | 46.6 | 5.83 | 53.0 | 5.67 | 65.3 | 3.68 | 69.8 | 2.85 | 66.6 | 5.66 | 61.8 | 4.61 | 54.5 | 3.10 | 43.0 | 6.37 | 39.0 | 4.97 |
| 1863 | 24.6 | 5.71 | 24.5 | 3.01 | 33.2 | 4.30 | 44.3 | 1.93 | 57.2 | 2.93 | 63.3 | 7.60 | 68.0 | 5.28 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 1864 | 23.2 | ..... | 27.4 | ..... | 32.6 | ..... | 41.4 | ..... | 57.8 | ..... | 62.2 | ..... | 67.0 | ..... | 67.4 | ..... | 56.8 | ..... | 48.4 | ..... | 47.1 | ..... | 30.5 | ..... |
| 1865 | 21.8 | 4.91 | 27.9 | 4.60 | 40.6 | 6.31 | 49.6 | 3.26 | 58.5 | 7.26 | 68.4 | 4.89 | 71.5 | 6.84 | 67.0 | 1.57 | 67.7 | 1.38 | 50.0 | 4.33 | 43.3 | 3.15 | 34.6 | 4.01 |
| 1866 | 27.2 | 1.71 | 31.7 | 6.45 | 36.3 | 3.41 | 53.2 | 2.89 | 57.8 | 5.80 | 66.4 | 4.31 | 74.0 | 3.28 | 65.5 | 4.21 | 63.0 | 6.17 | 51.0 | 4.21 | 42.8 | 4.95 | 30.3 | 4.38 |
| 1867 | 22.0 | 2.42 | 34.7 | 2.04 | 34.0 | 4.06 | 47.6 | 2.70 | 55.9 | 6.31 | 66.6 | 5.40 | 69.0 | 2.45 | 69.9 | 10.53 | 60.7 | 2.59 | 51.3 | 5.91 | 41.0 | 3.50 | 25.3 | 2.70 |
| 1868 | 23.0 | 4.55 | 16.7 | 1.69 | 35.5 | 2.66 | 42.3 | 5.58 | 55.4 | 7.79 | 65.0 | 3.67 | 74.3 | 2.44 | 70.0 | 7.27 | 71.0 | 8.40 | 47.1 | 0.93 | 39.2 | 4.31 | 25.7 | 2.47 |
| 1869 | 31.0 | 3.05 | 30.0 | 5.39 | 30.1 | 7.02 | 47.0 | 3.16 | 55.8 | 6.36 | 65.8 | 3.23 | 70.0 | 3.95 | 67.8 | 1.95 | 62.7 | 3.27 | 48.0 | 13.29 | 38.4 | 3.58 | 30.3 | 6.35 |
| 1870 | 33.2 | 6.38 | 27.1 | 5.19 | 23.0 | 5.60 | 48.4 | 6.21 | 59.0 | 1.39 | 70.9 | 3.12 | 74.0 | 2.95 | 71.8 | 2.11 | 63.0 | 1.40 | 55.6 | 5.37 | 43.3 | 3.43 | 32.4 | 2.19 |
| 1871 | 25.3 | 3.88 | 27.2 | 3.99 | 41.0 | 6.54 | ..... | ..... | ..... | ..... | ..... | ..... | 70.2 | 2.03 | 73.0 | 7.04 | 58.3 | 2.02 | 54.1 | 5.55 | 37.2 | 4.62 | 28.1 | 3.23 |
| 1872 | 27.8 | 1.47 | 26.6 | 2.99 | 27.5 | 4.16 | 46.5 | 1.72 | 59.8 | 3.60 | 69.5 | 4.23 | 74.4 | 5.02 | 73.1 | 6.96 | 64.0 | 4.31 | 50.4 | 2.70 | 39.1 | 5.38 | 23.4 | 3.66 |
| 1873 | 23.1 | 6.71 | 26.0 | 3.52 | 32.9 | 2.50 | 45.0 | 3.28 | 57.2 | 5.42 | 67.3 | 0.38 | 72.5 | 2.17 | 69.2 | 9.93 | 62.5 | 2.16 | 51.3 | 5.03 | 33.9 | 4.36 | 32.0 | 4.84 |
| 1874 | ..... | 6.51 | ..... | 3.88 | ..... | 1.53 | ..... | 7.88 | ..... | 3.78 | ..... | 1.93 | ..... | 4.54 | ..... | 7.13 | ..... | 3.29 | ..... | 1.30 | ..... | 3.12 | ..... | 2.32 |
| 1875 | ..... | 2.90 | ..... | 5.18 | ..... | 5.48 | ..... | 3.74 | ..... | 2.12 | ..... | 3.37 | ..... | 3.21 | ..... | 4.88 | ..... | 2.10 | ..... | 3.32 | ..... | 5.72 | ..... | 1.27 |
| 1876 | ..... | 1.36 | ..... | 5.26 | ..... | 10.90 | ..... | 4.98 | ..... | 3.61 | ..... | 1.40 | ..... | 10.01 | ..... | 1.69 | ..... | 5.00 | ..... | 1.43 | ..... | 4.37 | ..... | 4.19 |
| 1877 | ..... | 3.47 | ..... | 1.50 | ..... | 8.30 | ..... | 2.35 | ..... | 1.07 | ..... | 6.59 | ..... | 2.35 | ..... | 4.63 | ..... | 0.65 | ..... | 8.34 | ..... | 6.81 | ..... | 1.76 |
| 1878 | ..... | 5.81 | ..... | 5.71 | ..... | 2.95 | ..... | 4.73 | ..... | 3.44 | ..... | 3.97 | ..... | 3.40 | ..... | 3.90 | ..... | 4.87 | ..... | 2.73 | ..... | 5.87 | ..... | 7.06 |
| 1879 | ..... | 2.64 | ..... | 3.88 | ..... | 4.93 | ..... | 5.80 | ..... | 2.32 | ..... | 3.90 | ..... | 8.99 | ..... | 8.04 | ..... | 1.80 | ..... | 1.30 | ..... | 2.00 | ..... | 4.19 |
| 1880 | ..... | 4.09 | ..... | 3.79 | ..... | 3.63 | ..... | 4.39 | ..... | 1.16 | ..... | 3.04 | ..... | 5.36 | ..... | 4.62 | ..... | 3.86 | ..... | 3.89 | ..... | 3.87 | ..... | 3.00 |
| 1881 | ..... | 6.39 | ..... | 4.97 | ..... | 7.79 | ..... | 1.35 | ..... | 4.51 | ..... | 3.54 | ..... | 3.07 | ..... | 1.82 | ..... | 0.68 | ..... | 2.99 | ..... | 4.06 | ..... | 4.89 |
| 1882 | ..... | 5.98 | ..... | 6.99 | ..... | 4.14 | ..... | 1.33 | ..... | 4.51 | ..... | 2.40 | ..... | 2.43 | ..... | 1.51 | ..... | 11.90 | ..... | 3.03 | ..... | 1.62 | ..... | 3.86 |
| 1883 | ..... | 4.81 | ..... | 3.50 | ..... | 2.58 | ..... | 1.91 | ..... | 3.95 | ..... | 2.24 | ..... | 5.05 | ..... | 1.03 | ..... | 2.56 | ..... | 6.51 | ..... | 1.77 | ..... | 4.33 |
| 1884 | ..... | 5.16 | ..... | 6.06 | ..... | 5.40 | ..... | 2.98 | ..... | 3.94 | ..... | 4.52 | ..... | 3.92 | ..... | 5.32 | ..... | 0.91 | ..... | 3.40 | ..... | 2.73 | ..... | 7.33 |
| 1885 | ..... | 5.27 | ..... | 4.17 | ..... | 1.93 | ..... | 2.72 | ..... | 3.07 | ..... | 1.91 | ..... | 3.04 | ..... | 7.96 | ..... | 0.75 | ..... | 5.59 | ..... | 5.05 | ..... | 4.25 |
| 1886 | ..... | 5.37 | ..... | 8.71 | ..... | 3.67 | ..... | 4.20 | ..... | 3.72 | ..... | 2.78 | ..... | 4.23 | ..... | 3.23 | ..... | 2.98 | ..... | 2.73 | ..... | 4.68 | ..... | 5.93 |
| 1887 | ..... | 5.71 | ..... | 7.16 | ..... | 5.95 | ..... | 3.19 | ..... | 0.35 | ..... | 8.13 | ..... | 4.53 | ..... | 4.77 | ..... | 2.12 | ..... | 3.25 | ..... | ..... | ..... | ..... |

Maxima and minima temperatures at Wallingford, Conn., from 1864 to 1873.

| Year. | January. | | February. | | March. | | April. | | May. | | June. | | July. | | August. | | September. | | October. | | November. | | December. | |
|-------|----------|-------|-----------|-------|--------|-------|--------|------|------|------|-------|------|-------|------|---------|------|------------|------|----------|-------|-----------|------|-----------|-------|
| | Max. | Min. | Max. | Min. | Max. | Min. | Max. | Min. | Max. | Min. | Max. | Min. | Max. | Min. | Max. | Min. | Max. | Min. | Max. | Min. | Max. | Min. | Max. | Min. |
| 1864 | 48 | -10 | 44 | 2 | 52 | 12 | 69 | 18 | 76 | 32 | 88 | 44 | 90 | 25 | 78 | 44 | 74 | 42 | 68 | ..... | 68 | 20 | ..... | ..... |
| 1865 | 40 | -4 | 46 | 10 | 58 | 20 | 77 | 31 | 80 | 44 | 88 | 37 | 89 | 52 | 88 | 50 | 87 | 42 | 80 | 30 | 65 | 24 | 54 | 12 |
| 1866 | 45 | -1 | 56 | 10 | 63 | 20 | 82 | 30 | 80 | 44 | 89 | 59 | 84 | 58 | 84 | 50 | 84 | 44 | 70 | 31 | 63 | 24 | 53 | 9 |
| 1867 | 43 | 0 | 57 | 14 | 53 | 7 | 68 | 32 | 77 | 36 | 85 | 48 | 87 | 56 | 84 | 46 | 72 | 41 | 74 | 30 | 67 | 20 | 50 | 0 |
| 1868 | 40 | ..... | 40 | -11 | 58 | 0 | 68 | 32 | 73 | 36 | 86 | 48 | 87 | 61 | 86 | 52 | 85 | 36 | 70 | 22 | 61 | 24 | 40 | 7 |
| 1869 | 48 | 6 | 54 | 9 | 60 | 0 | 74 | 38 | 86 | 38 | 81 | 45 | 90 | 52 | 91 | 50 | 84 | 34 | 72 | 24 | 60 | 23 | 46 | 0 |
| 1870 | 39 | 6 | 51 | ..... | 59 | ..... | 74 | 38 | 84 | 40 | 90 | 52 | 90 | 58 | 91 | 50 | 84 | 40 | 75 | 29 | 62 | 20 | 53 | 1 |
| 1871 | 52 | -6 | 54 | -8 | 58 | 30 | 82 | 30 | 85 | 49 | 88 | 48 | 91 | 64 | 86 | 50 | 70 | 40 | 73 | 29 | 62 | 12 | 48 | -2 |
| 1872 | 45 | 3 | 48 | 6 | 48 | 1 | 82 | 30 | 85 | 49 | 88 | 48 | 91 | 64 | 86 | 50 | 70 | 40 | 73 | 29 | 62 | 12 | 48 | -2 |
| 1873 | 40 | 00 | 48 | -3 | 48 | 3 | 67 | 34 | 80 | 36 | 97 | 50 | 90 | 58 | 88 | 55 | 84 | 42 | 72 | 30 | 55 | 14 | 58 | 12 |

ATLANTIC WEATHER CHARTS

[Extracts from London Nautical Gazette, vol. 56, page 296, 1887.]

The Meteorological Council have for some time past been engaged in the preparation of synchronous weather charts of the north Atlantic and the adjacent continents for every day from 1st August, 1882, to 31st August, 1883, and for each day they have given two separate charts—one to show the barometric pressure, the wind, and the weather; the other to show the temperature of the air, and the sea, and the weather. The observations have been collected from a very large number of ships, and they supply the means of exhibiting, with very considerable precision, the principal elements of the weather for every day during the period * * * * The period embraced is that during which the international system of circumpolar observations was being carried out, and observations have thus been obtained from very high northern latitudes, which could not otherwise have been procurable, and, consequently the results embodied in the charts have not only been rendered far more complete, but are of an exceptional value, not likely to be soon equalled. * * * * The study of the weather of western Europe for many years has established, in a manner that is beyond question, that the atmospheric disturbances, on which the changes of weather are in a great measure, if not mainly, dependent, reach our western coasts after having passed for a longer or shorter distance over the Atlantic. * * * * The feature which probably stands out in greater prominence than any other in these charts is the general movement from west to east of the storm-centres or depressions in the middle latitudes, a confirmation of the law which has been for some time fully recognized * * * * In addition to these travelling depressions or disturbances, there is a decided tendency in the winter months to a permanent area of low barometer in the vicinity of Greenland and Iceland, on the southern border or edge of which the disturbances travel * * *

* * * There is also a permanent area of high barometer, or anti-cyclone, situated in the mid-Atlantic; this area oscillates somewhat in position, at one time being pushed further north than at another, and sometimes similarly varying its situation to the east or west, and much of the intensity of the Atlantic storms is due to the position of this anti-cyclone, since they invariably skirt its northern edge, and the westerly winds on the southern side of a disturbance are greatly augmented in strength if the high pressure area is well to the north, causing, as this does, a greater barometrical difference over a given area. The charts show how, when this area of high barometer readings extends farthest to the northward, the storm-centres of necessity take this route in a higher latitude across the Atlantic, and if they strike the coasts of Europe at all, they touch a very northerly point, and affect but slightly the weather of the British Islands. If, however, this anti-cyclonic area has a position farther to the southward, the storm systems also keep in a more southerly latitude, and are more likely to take a direct route for the British Islands. * * * At times this high-pressure area will extend to the coasts of Spain and France and even to the British Islands; in the latter case we enjoy a period of almost complete immunity from storms, although with these conditions prevailing on the European side of the Atlantic the atmosphere is usually in a very disturbed condition near the American coasts—storms on that side being unusually prolific. It is under such conditions as we have just described that the American storm warnings most completely fail * * *

The charts exhibit in the clearest possible manner the very different conditions of weather which prevail over the Atlantic in summer to those of the winter, the changes in the latter season being more frequent and of more serious character. The weather systems in the summer, although they possess the same principal features as those which characterize the winter storms, are wanting in energy, probably the results of less difference of temperature over a given area, and also to the presence of less aqueous vapor, which constitutes so important a factor in storm development. The summer disturbances * * are often productive of much rain, but it is somewhat exceptional for these to be accompanied by winds of great force. In the winter months, on the contrary, gales are of every day occurrence on some part of the area embraced by the charts, and very often several disturbances existing at one time; on October 10th there are no fewer than six storm-centres over the Atlantic at the same moment, as shown by the synchronous chart for that day, and each of these was accompanied by winds of gale force * * *

These charts afford to the navigator the most complete study of the weather. They show, in a graphic manner, how a vessel may be involved in a gale for days together; and how one gale after another is met with on a passage with scarcely a break of fine weather between them. They show that when very disturbed conditions are prevailing over the Atlantic, a vessel may be within an hour or two's sail or steam of bad weather, although there is no indication of the approach of such bad weather at the position of the ship. * * *

* * * The charts afford a bird's-eye-view of winds and weather over the north Atlantic and the adjacent continents, they show the meeting of the northeast and southeast trades; the southeast trade extending well across the equator into the northern hemisphere throughout the period, but its limit is shown to be several degrees farther north in August than in October and November * * * The charts show that in August the temperature of both air and sea in 35° north latitude is about 10° warmer on the western side of the Atlantic than on the eastern, whilst north of 45° N. the reverse is the case, the temperature contiguous to the coasts of England being decidedly warmer than in the same latitude on the Labrador coast, the latter difference becoming much more marked as winter is approached. The result of these differences is a very decided packing together of its isotherms on the western side of the Atlantic whilst they open out on the eastern side * * * There is a wonderful agreement between the temperature of the air and sea

over the ocean, but at the end of summer the air temperature is slightly the warmer to the extent of 2° or 3°, but as winter is approached the sea is slightly warmer than the air.

Table of monthly mean temperatures at Lima, Ohio, from January, 1865, to October, 1887, inclusive, and monthly precipitation from January, 1881, to October, 1887, inclusive, from observations made by Mr. F. Y. Davis.

Temperature, in degrees Fahrenheit.

| Year. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|-----------|------|------|------|------|------|------|------|------|-------|------|-------|-------|
| 1865..... | 17.1 | 28.5 | 41.9 | 51.8 | 60.1 | 73.0 | 70.3 | 68.2 | 70.8 | 68.5 | 57.1 | 29.8 |
| 1866..... | 24.3 | 24.7 | 33.4 | 54.2 | 57.2 | 67.8 | 74.0 | 63.9 | 60.2 | 52.8 | 38.3 | 24.9 |
| 1867..... | 16.3 | 32.8 | 30.3 | 49.6 | 52.8 | 71.7 | 72.3 | 71.5 | 66.7 | 53.2 | 43.6 | 28.0 |
| 1868..... | 20.2 | 23.6 | 42.1 | 45.1 | 58.7 | 68.1 | 79.0 | 70.0 | 58.9 | 47.8 | 38.9 | 24.2 |
| 1869..... | 31.8 | 31.3 | 31.5 | 46.9 | 57.6 | 66.8 | 71.2 | 72.4 | 63.7 | 42.2 | 33.0 | 30.0 |
| 1870..... | 28.3 | 27.5 | 33.7 | 52.2 | 64.0 | 69.2 | 74.7 | 71.9 | 67.4 | 53.3 | 38.8 | 25.4 |
| 1871..... | 29.7 | 31.6 | 45.3 | 53.9 | 63.0 | 69.9 | 71.1 | 73.1 | 60.0 | 54.0 | 35.5 | 24.7 |
| 1872..... | 22.9 | 25.3 | 30.3 | 52.2 | 62.0 | 70.3 | 75.3 | 72.8 | 64.8 | 50.9 | 32.2 | 18.7 |
| 1873..... | 21.3 | 25.7 | 33.9 | 48.4 | 61.9 | 72.4 | 72.4 | 71.4 | 61.5 | 47.3 | 32.6 | 33.3 |
| 1874..... | 30.4 | 30.8 | 37.8 | 42.3 | 64.8 | 73.7 | 74.7 | 72.9 | 67.4 | 51.9 | 28.3 | 32.1 |
| 1875..... | 17.6 | 17.5 | 33.9 | 45.2 | 60.2 | 67.1 | 71.9 | 66.3 | 59.9 | 48.5 | 36.0 | 37.2 |
| 1876..... | 35.1 | 32.6 | 33.9 | 48.8 | 62.7 | 70.0 | 73.9 | 63.0 | 62.0 | 47.8 | 39.0 | 18.2 |
| 1877..... | 22.4 | 23.8 | 32.3 | 50.5 | 57.6 | 68.1 | 72.6 | 71.5 | 63.4 | 54.7 | 38.8 | 40.3 |
| 1878..... | 28.3 | 31.1 | 43.3 | 56.2 | 59.3 | 65.3 | 74.6 | 71.9 | 63.0 | 54.0 | 39.9 | 22.2 |
| 1879..... | 20.4 | 24.4 | 28.3 | 48.4 | 63.2 | 68.7 | 74.7 | 67.7 | 58.1 | 58.8 | 40.5 | 34.5 |
| 1880..... | 42.1 | 37.1 | 39.1 | 52.2 | 67.6 | 71.4 | 73.4 | 72.7 | 63.5 | 50.9 | 31.7 | 23.1 |
| 1881..... | 20.2 | 26.6 | 32.0 | 44.9 | 66.3 | 68.4 | 73.6 | 70.4 | 68.1 | 56.3 | 39.6 | 25.1 |
| 1882..... | 28.7 | 38.4 | 40.1 | 52.0 | 63.7 | 66.9 | 68.6 | 73.7 | 64.2 | 56.8 | 42.6 | 27.8 |
| 1883..... | 23.3 | 29.7 | 34.0 | 48.8 | 62.0 | 71.0 | 73.0 | 68.6 | 63.3 | 55.1 | 44.3 | 31.7 |
| 1884..... | 18.1 | 31.7 | 37.7 | 45.9 | 60.7 | 74.8 | 75.2 | 71.5 | 69.7 | 58.5 | 36.7 | 28.7 |
| 1885..... | 21.9 | 19.1 | 27.9 | 51.6 | 61.7 | 66.7 | 75.4 | 72.4 | 68.6 | 52.0 | 41.6 | 32.9 |
| 1886..... | 24.3 | 29.8 | 40.1 | 57.8 | 63.8 | 74.1 | 74.0 | 74.1 | 68.5 | 54.6 | 39.8 | 32.8 |
| 1887..... | 27.1 | 36.1 | 37.9 | 60.4 | 67.0 | 72.8 | 73.6 | 70.2 | 70.2 | 54.3 | ..... | ..... |

Precipitation, in inches.

| Year. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|-----------|------|------|------|------|-----|------|------|------|-------|------|-------|-------|
| 1881..... | 6.7 | 7.0 | 9.2 | 3.3 | 2.9 | 5.7 | 3.6 | 0.9 | 1.2 | 4.7 | 4.6 | 4.9 |
| 1882..... | 2.2 | 4.0 | 3.3 | 2.0 | 5.1 | 4.7 | 2.9 | 7.6 | 1.2 | 2.6 | 3.2 | 3.0 |
| 1883..... | 2.8 | 8.4 | 0.4 | 4.1 | 7.5 | 6.7 | 5.9 | 2.2 | 2.5 | 5.5 | 4.1 | 4.5 |
| 1884..... | 3.7 | 5.6 | 2.3 | 3.0 | 3.9 | 1.8 | 4.4 | 2.6 | 1.9 | 1.4 | 3.2 | 4.2 |
| 1885..... | 5.0 | 1.8 | 1.2 | 4.0 | 5.8 | 4.3 | 1.6 | 4.7 | 2.2 | 2.1 | 1.6 | 1.5 |
| 1886..... | 3.1 | 1.6 | 2.4 | 3.6 | 4.2 | 2.8 | 0.4 | 6.2 | 4.9 | 1.6 | 3.6 | 6.8 |
| 1887..... | 4.0 | 6.6 | 2.4 | 3.1 | 6.2 | 4.6 | 2.1 | 3.2 | 1.3 | 1.5 | ..... | ..... |

Total for 1881, 56.7; 1882, 41.8; 1883, 54.6; 1884, 37.0; 1885, 35.8; 1886, 41.2.

Note.—Observations of temperature were made at sunrise, 1 p. m., and sunset, and the mean is found by dividing the sum by three.

The following are extracts from a paper entitled "Notes on the climate of the Fiji Islands," S. 18° 30', E. 179°, furnished Mr. George H. Boehmer, Chief Exchange Division, Smithsonian Institution, by Mr. W. H. Bruce, vice-commercial agent at Levuka, Fiji, and represent an uninterrupted series of monthly meteorological values obtained from observations taken during a period of eleven years by Mr. J. W. D. Vaughan, Her Majesty's storekeeper at Suva, Fiji. From January 1, 1875, to August, 1882, the observations were taken at Levuka, Fiji, and from August, 1882, to December 31, 1885, they were made at Suva, Fiji. The barometric values are corrected for temperature and instrumental error:

Atmospheric pressure.

| Month. | 1875. | 1876. | 1877. | 1878. | 1879. | 1880. | 1881. | 1882. | 1883. | 1884. | 1885. | Means for 11 years. |
|--------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|---------------------|
| January... | 29.77 | 29.11 | 29.79 | 29.94 | 29.90 | 29.83 | 29.77 | 29.72 | 29.76 | 29.85 | 29.79 | 29.75 |
| February... | 29.03 | 29.42 | 29.87 | 29.96 | 29.92 | 29.94 | 29.80 | 29.85 | 29.79 | 29.83 | 29.86 | 29.75 |
| March..... | 29.52 | 29.70 | 30.18 | 29.92 | 29.99 | 29.96 | 29.89 | 29.82 | 29.81 | 29.90 | 29.83 | 29.87 |
| April..... | 29.83 | 29.80 | 29.87 | 30.02 | 30.01 | 30.03 | 29.94 | 29.92 | 29.91 | 29.94 | 29.88 | 29.92 |
| May..... | 29.89 | 29.90 | 29.99 | 30.06 | 30.02 | 30.01 | 29.99 | 29.91 | 29.97 | 29.97 | 29.94 | 29.98 |
| June..... | 29.89 | 29.90 | 30.05 | 30.09 | 30.09 | 30.07 | 30.00 | 29.98 | 29.98 | 30.02 | 30.07 | 30.00 |
| July..... | 29.90 | 29.91 | 30.05 | 30.10 | 30.10 | 29.99 | 29.96 | 30.01 | 30.03 | 30.05 | 30.03 | 30.03 |
| August..... | 29.90 | 29.91 | 30.01 | 30.12 | 30.14 | 30.01 | 30.03 | 30.01 | 30.03 | 30.04 | 30.03 | 30.03 |
| September... | 29.90 | 29.90 | 30.10 | 30.14 | 30.11 | 30.01 | 30.01 | 29.99 | 30.00 | 30.06 | 30.08 | 30.03 |
| October..... | 29.89 | 29.90 | 30.06 | 30.08 | 30.07 | 29.99 | 29.98 | 30.04 | 29.99 | 30.06 | 30.09 | 30.01 |
| November... | 29.55 | 29.74 | 30.32 | 30.01 | 29.99 | 29.88 | 29.88 | 29.87 | 29.91 | 29.95 | 29.99 | 29.92 |
| December... | 29.76 | 29.53 | 29.92 | 29.95 | 29.90 | 30.17 | 29.79 | 29.79 | 29.84 | 29.88 | 29.92 | 29.86 |
| Means..... | 29.74 | 29.73 | 30.02 | 30.03 | 29.99 | 29.92 | 29.91 | 29.92 | 29.96 | 29.96 | 29.93 | 29.93 |

Mean temperature.

| Month. | 1875. | 1876. | 1877. | 1878. | 1879. | 1880. | 1881. | 1882. | 1883. | 1884. | 1885. | Means for 11 years. |
|--------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|---------------------|
| January... | 82.0 | 82.0 | 82.0 | 82.0 | 81.0 | 82.0 | 83.0 | 82.0 | 83.0 | 80.0 | 81.0 | 81.8 |
| February... | 82.0 | 84.0 | 82.0 | 82.0 | 80.0 | 81.0 | 81.0 | 83.0 | 80.0 | 80.0 | 83.0 | 81.6 |
| March..... | 80.0 | 81.0 | 81.0 | 81.0 | 82.0 | 82.0 | 82.0 | 81.0 | 82.0 | 82.0 | 82.0 | 81.5 |
| April..... | 79.0 | 79.0 | 80.0 | 79.0 | 81.0 | 79.0 | 82.0 | 82.0 | 80.0 | 79.0 | 81.0 | 80.1 |
| May..... | 79.0 | 78.0 | 82.0 | 79.0 | 80.0 | 80.0 | 78.0 | 80.0 | 78.0 | 76.0 | 77.0 | 78.8 |
| June..... | 78.0 | 77.0 | 75.0 | 77.0 | 78.0 | 78.0 | 79.0 | 78.0 | 75.0 | 76.0 | 75.0 | 76.9 |
| July..... | 76.0 | 75.0 | 74.0 | 75.0 | 78.0 | 76.0 | 77.0 | 75.0 | 74.0 | 73.0 | 74.0 | 75.2 |
| August..... | 78.0 | 75.0 | 73.0 | 75.0 | 76.0 | 76.0 | 77.0 | 80.0 | 74.0 | 73.0 | 71.0 | 74.3 |
| September... | 78.0 | 76.0 | 74.0 | 76.0 | 77.0 | 75.0 | 79.0 | 77.0 | 75.0 | 73.0 | 73.0 | 75.6 |
| October..... | 79.0 | 77.0 | 76.0 | 76.0 | 78.0 | 77.0 | 80.0 | 78.0 | 76.0 | 76.0 | 75.0 | 77.1 |
| November... | 79.0 | 78.0 | 79.0 | 78.0 | 80.0 | 79.0 | 83.0 | 81.0 | 79.0 | 79.0 | 77.0 | 79.3 |
| December... | 80.0 | 78.0 | 81.0 | 80.0 | 80.0 | 81.0 | 81.0 | 83.0 | 79.0 | 82.0 | 80.0 | 80.4 |
| Means..... | 79.2 | 78.3 | 78.2 | 78.3 | 79.2 | 78.8 | 80.2 | 80.0 | 77.9 | 77.4 | 77.3 | 78.6 |

Monthly rainfall.

| Month. | 1875. | 1876. | 1877. | 1878. | 1879. | 1880. | 1881. | 1882. | 1883. | 1884. | 1885. | Means for 11 years. |
|--------------|--------|--------|-------|-------|-------|--------|--------|--------|--------|-------|-------|---------------------|
| January... | 11.66 | 10.82 | 12.40 | 8.52 | 15.29 | 14.02 | 19.94 | 11.80 | 7.31 | 4.40 | 12.81 | 11.72 |
| February... | 9.82 | 8.76 | 9.29 | 5.37 | 12.64 | 7.62 | 19.96 | 12.77 | 13.25 | 18.77 | 5.62 | 11.26 |
| March..... | 23.98 | 17.39 | 12.67 | 16.09 | 11.42 | 13.62 | 11.64 | 11.78 | 9.08 | 15.59 | 9.88 | 13.92 |
| April..... | 18.95 | 13.54 | 4.12 | 17.18 | 12.97 | 22.35 | 8.00 | 2.72 | 9.12 | 8.71 | 10.69 | 11.61 |
| May..... | 6.86 | 2.64 | 0.76 | 1.74 | 7.67 | 5.91 | 2.13 | 22.59 | 4.84 | 6.96 | 6.03 | 6.20 |
| June..... | 16.06 | 3.42 | 6.77 | 0.20 | 4.21 | 0.45 | 2.94 | 1.40 | 12.23 | 2.58 | 0.83 | 5.10 |
| July..... | 2.21 | 1.32 | 7.16 | 1.38 | 5.60 | 5.83 | 9.46 | 8.25 | 3.23 | 4.46 | 2.55 | 4.40 |
| August..... | 2.62 | 5.55 | 11.04 | 2.86 | 2.44 | 10.66 | 14.19 | 3.88 | 7.39 | 5.53 | 9.00 | 6.83 |
| September... | 8.00 | 5.12 | 2.79 | 0.89 | 4.89 | 2.60 | 6.14 | 3.71 | 3.79 | 13.43 | 6.64 | 5.23 |
| October..... | 7.07 | 6.68 | 5.47 | 3.75 | 8.94 | 20.29 | 8.95 | 5.82 | 7.17 | 0.51 | 3.47 | 7.08 |
| November... | 7.21 | 7.65 | 0.03 | 11.35 | 4.84 | 9.47 | 10.43 | 28.73 | 18.05 | 9.86 | 3.51 | 10.10 |
| December... | 5.05 | 22.71 | 0.88 | 3.31 | 6.17 | 15.52 | 22.11 | 10.69 | 14.46 | 3.29 | 5.32 | 9.95 |
| Totals..... | 119.49 | 104.60 | 73.38 | 72.64 | 97.08 | 134.34 | 135.89 | 123.74 | 108.85 | 92.08 | 78.35 | 103.68 |

| Station and district. | Elevation above level, feet. | Atmospheric pressure, in inches and hundredths. | | | | Temperature of the air, in degrees Fahrenheit. | | | | | | | | | | | | Winds. | | | | | | | | | | | | | | | | |
|-----------------------------|------------------------------|---|------------------------|-------------------------|--------------------|--|---------------|------------------------|------|-------|-----------|-----------|-------|---------------|----------------|-----------------------------------|--|---------------------------|---|------------------------|-----------------------|-------------------|--------|--------------------|---------------------|-------------------|-------------|------------|-----|----|----|-----|----|----|
| | | Mean actual barometer. | Departure from normal. | Mean reduced barometer. | Extremes. | | Monthly mean. | Departure from normal. | Max. | Date. | Mean max. | Extremes. | | Daily ranges. | | Mean relative humidity, per cent. | Mean temperature of dew-point, degrees Fahrenheit. | Precipitation, in inches. | Departure from normal precipitation, in inches. | Total movement, miles. | Prevailing direction. | Maximum velocity. | | No. of rainy days. | No. of cloudy days. | No. of fair days. | | | | | | | | |
| | | | | | Highest barometer. | Lowest barometer. | | | | | | Min. | Date. | Mean min. | Monthly range. | | | | | | | Greatest. | Least. | | | | Miles p. h. | Direction. | | | | | | |
| <i>New England.</i> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Eastport | 61 | 29.89 | -.10 | 29.95 | 30.55 | 27 | 29.23 | 21 | 1.32 | 49.7 | 1.9 | 64.0 | 7 | 52.3 | 26.5 | 31 | 40.4 | 37.5 | 21.4 | 24 | 3.8 | 275.0 | 38.4 | 2.90 | -1.64 | 6,273 | sw. | 35 | se. | 21 | 9 | 519 | 6 | 7 |
| Portland | 99 | 29.87 | -.10 | 29.97 | 30.54 | 26 | 29.30 | 21 | 1.24 | 47.6 | 3.4 | 69.3 | 18 | 55.1 | 27.9 | 31 | 38.7 | 41.4 | 29.0 | 16 | 4.2 | 470.9 | 37.9 | 2.47 | -1.33 | 5,151 | nw. | 36 | se. | 24 | 11 | 916 | 6 | 7 |
| Manchester | 29 | 29.74 | -.10 | 29.84 | 30.54 | 26 | 29.30 | 21 | 1.15 | 47.5 | 3.5 | 72.0 | 10 | 58.7 | 37.4 | 16 | 38.0 | 47.9 | 39.9 | 16 | 4.2 | 713.3 | 37.5 | 1.98 | ..... | 3,936 | nw. | 32 | sw. | 24 | 6 | 715 | 9 | 7 |
| Mt. Washington | 6,288 | 29.03 | ..... | 29.98 | 30.54 | 26 | 29.43 | 21 | 1.11 | 43.4 | 5.6 | 70.1 | 10 | 52.2 | 18.6 | 31 | 34.0 | 51.5 | 41.3 | 15 | 5.0 | 221.5 | 37.6 | 1.47 | ..... | 6,108 | s. | 45 | sw. | 24 | 16 | 13 | 14 | 14 |
| Northfield | 144 | 29.87 | -.10 | 29.98 | 30.53 | 26 | 29.40 | 21 | 1.13 | 53.0 | 1.0 | 73.7 | 7 | 58.9 | 27.2 | 31 | 44.2 | 45.9 | 27.4 | 16 | 4.3 | 217.6 | 43.4 | 2.53 | -1.69 | 7,474 | w. | 46 | sw. | 24 | 7 | 10 | 17 | 17 |
| Edgemoor | 14 | 29.99 | -.09 | 29.99 | 30.46 | 26 | 29.38 | 21 | 1.08 | 52.8 | 0.5 | 66.7 | 4 | 57.9 | 33.5 | 16 | 46.3 | 53.0 | 24.7 | 14 | 4.9 | 299 | 43.4 | 1.88 | ..... | 7,492 | w. | 40 | nw. | 21 | 12 | 11 | 12 | 8 |
| Wood's Holl | 33 | 29.03 | -.08 | 29.03 | 30.54 | 26 | 29.44 | 21 | 1.10 | 52.3 | 0.8 | 65.9 | 7 | 57.7 | 33.8 | 31 | 47.3 | 51.3 | 26.2 | 13 | 6.2 | 255.0 | 51.0 | 2.21 | ..... | 10,997 | w. | 40 | nw. | 21 | 12 | 11 | 12 | 8 |
| Block Island | 37 | 29.98 | -.10 | 29.98 | 30.48 | 26 | 29.43 | 21 | 1.05 | 51.4 | 0.9 | 70.5 | 4 | 59.7 | 36.0 | 31 | 49.3 | 54.5 | 17.2 | 17 | 3.1 | 285.1 | 47.8 | 2.28 | -1.80 | 10,873 | sw. | 48 | n. | 21 | 8 | 12 | 11 | 8 |
| Narragansett Pier | 107 | 29.90 | -.10 | 29.90 | 30.49 | 26 | 29.48 | 21 | 1.01 | 53.1 | 1.9 | 74.7 | 7 | 59.5 | 24.9 | 31 | 43.0 | 49.8 | 29.0 | 16 | 5.6 | 171.2 | 41.4 | 3.24 | -0.49 | 5,321 | n. | 35 | w. | 22 | 9 | 915 | 7 | 7 |
| New Haven | 47 | 29.98 | -.09 | 29.98 | 30.45 | 26 | 29.43 | 21 | 1.03 | 51.1 | 0.9 | 73.7 | 10 | 60.4 | 29.9 | 31 | 45.4 | 52.5 | 15.6 | 16 | 7.4 | 275.6 | 45.4 | 4.28 | -0.08 | 4,924 | nw. | 32 | sw. | 24 | 8 | 10 | 15 | 5 |
| <i>Mt. Atlantic States.</i> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Albany | 86 | 29.94 | -.09 | 29.94 | 30.56 | 26 | 29.49 | 21 | 1.07 | 55.2 | 2.5 | 70.9 | 10 | 58.0 | 26.1 | 31 | 41.6 | 44.8 | 27.9 | 17 | 4.4 | 172.2 | 40.2 | 2.22 | -1.00 | 3,942 | s. | 36 | s. | 24 | 9 | 14 | 12 | 5 |
| New York City | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

| Elevation above sea-level, feet. | Atmospheric pressure, in inches and hundredths. | | | | Temperature of the air, in degrees Fahrenheit. | | | | | | | | | | | | | | Winds. | | | | | | | | | | | |
|----------------------------------|---|------------------------|-------------------------|--------------------|--|---------------|------------------------|-----------|----------------|---------------|--------|-------------|-----------------------------------|--|---------------------------|---|------------------------|-----------------------|-------------------|-------|--------------------|---------------------|--------------------|-------|-----|----|---|---|----|----|
| | Mean actual barometer. | Departure from normal. | Mean reduced barometer. | Extremes. | | Monthly mean. | Departure from normal. | Extremes. | | Daily ranges. | | | Mean relative humidity, per cent. | Mean temperature of dew-point, degrees Fahrenheit. | Precipitation, in inches. | Departure from normal precipitation, in inches. | Total movement, miles. | Prevailing direction. | Maximum velocity. | | No. of rainy days. | No. of cloudy days. | No. of clear days. | | | | | | | |
| | | | | Highest barometer. | Lowest barometer. | | | Mean min. | Monthly range. | Greatest. | Least. | Miles p. h. | | | | | | | Direction. | | | | | | | | | | | |
| | | | | Date. | Date. | | | Date. | Date. | Date. | Date. | Date. | | | | | | | Date. | Date. | | | | Date. | | | | | | |
| 831 | 29.11 | +0.01 | 30.02 | 30.56 | 29.47 | 21.09 | 48.9 | -5.5 | 72.4 | 8 | 53.6 | 11.5 | 33 | 1.60 | 9.37 | 1.31 | 9.5 | 9.74 | 1 | 1.57 | -1.65 | 4,382 | nw. | 35 | nw. | 2 | 7 | 8 | 14 | 9 |
| 725 | 29.25 | +0.01 | 30.06 | 30.61 | 29.55 | 21.96 | 44.3 | -6.7 | 82.5 | 7 | 54.1 | 6.2 | 25 | 35.176 | 3.33 | 0.31 | 7.1 | 23.66 | 7 | 1.62 | -0.90 | 7,052 | nw. | 33 | sw. | 19 | 7 | 9 | 15 | 7 |
| 615 | 29.40 | +0.01 | 30.06 | 30.61 | 29.55 | 21.96 | 44.3 | -6.7 | 82.5 | 7 | 54.1 | 6.2 | 25 | 35.176 | 3.33 | 0.31 | 7.1 | 23.66 | 7 | 1.62 | -0.90 | 7,052 | nw. | 33 | sw. | 19 | 7 | 9 | 15 | 7 |
| 865 | 29.15 | +0.02 | 30.07 | 30.61 | 29.61 | 21.96 | 48.4 | -4.6 | 83.6 | 7 | 60.2 | 13.8 | 25 | 38.268 | 3.71 | 0.31 | 9.8 | 8.65 | 9 | 1.40 | -3.03 | 6,316 | nw. | 27 | sw. | 19 | 7 | 4 | 13 | 5 |
| 665 | 29.34 | +0.01 | 30.06 | 30.62 | 29.51 | 21.11 | 46.3 | -5.7 | 85.1 | 7 | 56.5 | 14.6 | 25 | 37.270 | 3.33 | 0.31 | 5.5 | 7.30 | 7 | 2.22 | -0.98 | 3,971 | nw. | 25 | sw. | 19 | 6 | 5 | 12 | 5 |
| 618 | 29.42 | +0.02 | 30.08 | 30.63 | 29.58 | 21.05 | 50.0 | -5.0 | 84.1 | 7 | 61.1 | 20.3 | 25 | 40.963 | 3.31 | 0.31 | 10.1 | 17.62 | 3 | 1.98 | -1.51 | 6,349 | nw. | 28 | se. | 22 | 7 | 4 | 13 | 5 |
| 359 | 29.74 | +0.01 | 30.10 | 30.42 | 29.81 | 23.06 | 55.1 | -4.9 | 82.5 | 9 | 67.1 | 27.7 | 30 | 46.154 | 3.82 | 0.31 | 11.2 | 23.62 | 3 | 0.38 | -2.73 | 6,347 | nw. | 40 | n. | 25 | 4 | 8 | 7 | 16 |
| 644 | 29.42 | +0.01 | 30.10 | 30.60 | 29.60 | 23.08 | 50.4 | -5.6 | 84.5 | 6 | 61.0 | 24.5 | 25 | 43.362 | 3.38 | 0.31 | 6.10 | 9.66 | 3 | 0.85 | -3.27 | 6,304 | nw. | 31 | w. | 3 | 4 | 5 | 11 | 11 |
| 571 | 29.50 | +0.02 | 30.09 | 30.54 | 29.66 | 23.08 | 54.4 | -4.6 | 86.5 | 6 | 65.2 | 24.0 | 25 | 43.362 | 3.34 | 0.31 | 10.4 | 24.55 | 3 | 0.70 | -2.17 | 8,316 | n. | 54 | s. | 23 | 5 | 3 | 11 | 7 |
| 1,028 | 29.56 | ..... | ..... | ..... | ..... | ..... | 48.0 | -3.4 | 86.9 | 6 | 64.8 | 19.9 | 27 | 37.067 | 3.46 | 1.35 | 11.9 | 7.69 | 7 | 0.59 | -0.53 | 3,500 | se. | 24 | w. | 23 | 4 | 3 | 10 | 18 |
| 842 | 29.68 | ..... | 30.13 | 30.53 | 29.72 | 22.08 | 53.6 | -5.4 | 86.7 | 6 | 66.5 | 21.6 | 30 | 42.265 | 1.39 | 1.31 | 7.9 | 7.69 | 0 | 1.94 | +0.01 | 6,912 | n. | 37 | s. | 22 | 5 | 6 | 20 | 18 |
| ..... | 29.22 | +0.04 | 30.10 | 30.59 | 29.59 | 22.07 | 52.6 | -3.4 | 89.3 | 6 | 65.4 | 23.2 | 25 | 43.407 | 1.38 | 0.31 | 9.5 | 10.68 | 5 | 2.08 | ..... | 7,078 | n. | 40 | s. | 22 | 5 | 6 | 20 | 18 |
| ..... | 29.02 | +0.04 | 30.11 | 30.64 | 29.52 | 21.08 | 52.0 | -0.6 | 90.3 | 6 | 66.4 | 23.2 | | | | | | | | | | | | | | | | | | |

* Record for 22 days. †100.5

*Meteorological record of voluntary observers and Army post surgeons,
October, 1887.*

The maximum and minimum temperatures at stations marked thus (*) are from readings of other than standard instruments.

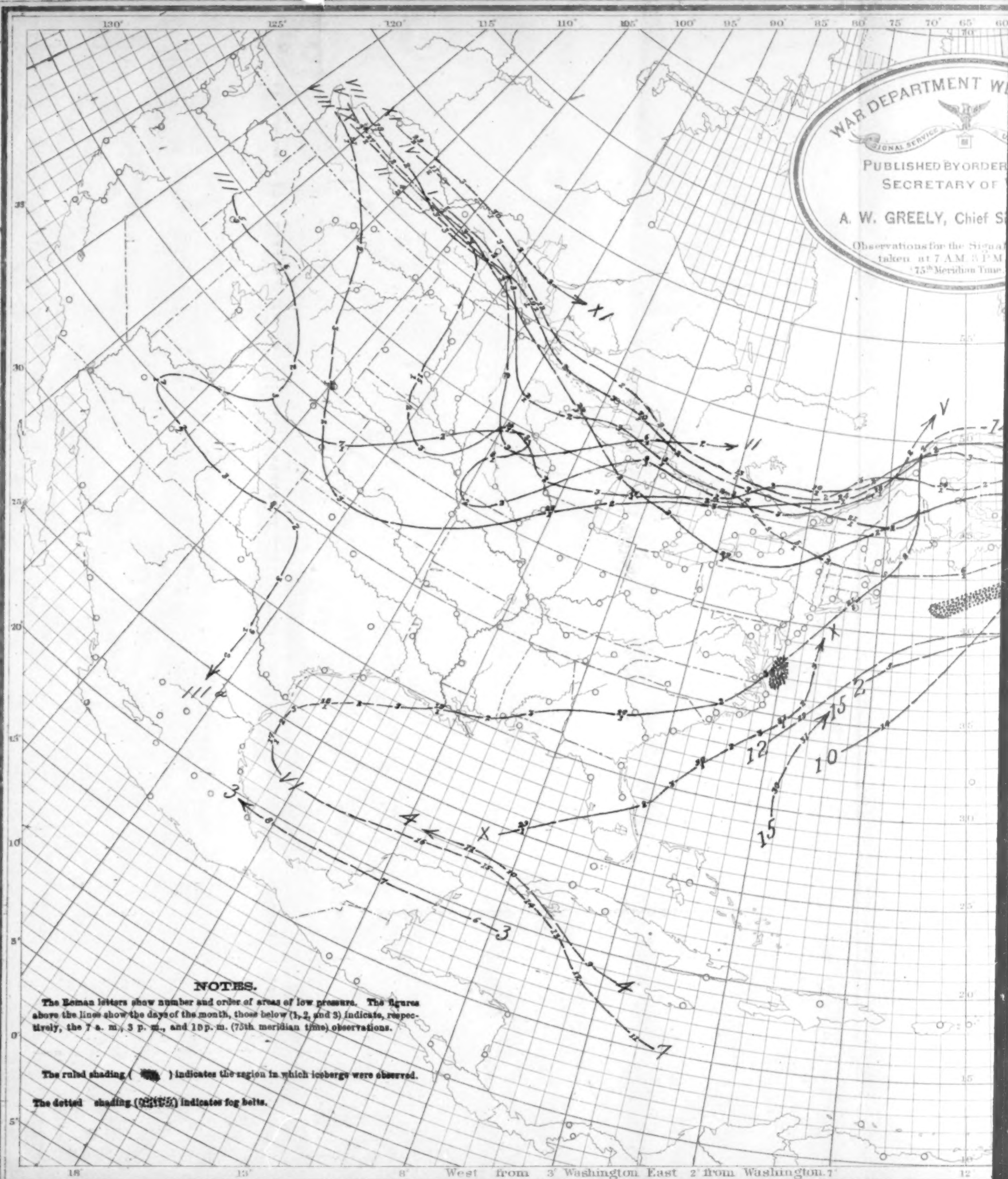
| Stations. | Temperature. (Fahrenheit.) | | | Precipitation. | Stations. | Temperature. (Fahrenheit.) | | | Precipitation. |
|------------------------------|-------------------------------|----------|-------|----------------|--------------------------|-------------------------------|----------|-------|----------------|
| | Maximum. | Minimum. | Mean. | | | Maximum. | Minimum. | Mean. | |
| <i>Alabama.</i> | | | | <i>Inches</i> | <i>Indiana—Con'd.</i> | | | | <i>Inches</i> |
| Livingston..... | 81 | 33 | 63.5 | 4.93 | Vevay..... | 86 | 24 | 52.6 | 0.67 |
| Mt. Vernon B'ks.... | 90 | 33 | 66.5 | 4.05 | <i>Indian Territory.</i> | | | | |
| <i>Arizona.</i> | | | | | Gibson, Fort..... | 90 | 26 | 57.6 | 2.14 |
| Huehucua, Fort..... | 92 | 36 | 61.5 | 0.77 | Reno, Fort..... | 89 | 28 | 57.1 | 6.01 |
| McDowell, Fort..... | 101 | 43 | 70.5 | 0.44 | Supply, Fort..... | 92 | 20 | 55.9 | 0.56 |
| Mojave, Fort..... | 108 | 25 | 75.6 | 0.45 | <i>Iowa.</i> | | | | |
| Tucson..... | | | | 1.72 | Bancroft..... | 79 | 3 | 42.8 | 0.67 |
| <i>Arkansas.</i> | | | | | Cedar Rapids..... | 80 | 11 | 46.5 | 2.07 |
| Hot Springs..... | 90 | 33 | 58.3 | 2.44 | Cedar Rapids..... | 84 | 8 | 44.5 | 2.20 |
| Lead Hill..... | 95 | 23 | | 1.50 | Clinton..... | 86 | 14 | 44.5 | 2.73 |
| <i>British Columbia.</i> | | | | | Cresco..... | 78 | 3 | 41.9 | 1.53 |
| New Westminster..... | 65 | 40 | 52.6 | 6.09 | Fort Madison..... | 83 | 17 | | 2.19 |
| <i>California.</i> | | | | | Humboldt..... | 75 | 18 | 44.0 | 1.03 |
| Alcatraz Island..... | 85 | 50 | 60.0 | 0.00 | Independence..... | 75 | 18 | 44.7 | 1.25 |
| Angel Island..... | 95 | 49 | 63.5 | 0.00 | Logan..... | 82 | 8 | | 0.90 |
| Benicia Barracks..... | 87 | 52 | 66.0 | 0.00 | Monticello..... | 82 | 8 | 43.8 | 1.39 |
| Bidwell, Fort..... | 86 | 25 | 53.2 | 0.00 | Mount Vernon..... | 86 | 13 | 47.7 | 2.05 |
| Cahuenga..... | | | | 0.13 | Muscataine..... | 86 | 14 | 47.7 | 2.24 |
| Gaston, Fort..... | 89 | 25 | | 0.20 | <i>Kansas.</i> | | | | |
| Hydesville..... | | | | 0.30 | East Norway..... | 86 | 26 | 51.1 | 1.80 |
| Lewis Creek..... | 97 | 48 | 72.0 | 0.13 | Elk Falls..... | | | | 2.01 |
| Mason, Fort..... | 80 | 52 | 61.6 | 0.00 | El Dorado..... | | | | 3.28 |
| Nicolaus..... | 96 | 48 | 68.6 | 0.00 | Globe..... | 85 | 22 | 52.5 | 4.46 |
| Oakland..... | 89 | 46 | 61.0 | 0.00 | Emporia..... | 84 | 31 | 54.4 | 2.84 |
| Oroville..... | 91 | 45 | 68.4 | 0.00 | Hays, Fort..... | 98 | 12 | 52.2 | 2.32 |
| Poway..... | 92 | 48 | 62.6 | 0.00 | Independence..... | 89 | 27 | 54.8 | 2.61 |
| Presidio of San F..... | 89 | 42 | 59.6 | 0.00 | Lawrence..... | 87 | 26 | 52.0 | 3.83 |
| Riverside..... | 94 | 42 | 66.5 | 0.86 | Lebo..... | 92 | 22 | 53.2 | 3.13 |
| Sacramento..... | 87 | 37 | 58.4 | 0.00 | Manhattan..... | 93 | 19 | 51.1 | 2.23 |
| Salinas..... | 92 | 42 | 58.5 | 0.00 | Morse..... | 72 | 20 | | 3.87 |
| Santa Barbara..... | 92 | 48 | 65.0 | 0.31 | Ninnescah..... | 94 | 16 | 53.0 | 1.54 |
| Willows..... | 97 | 42 | 68.8 | 0.00 | Riley, Fort..... | 90 | 19 | 54.0 | 2.06 |
| <i>Colorado.</i> | | | | | Salinas..... | 76 | 33 | 56.3 | 1.40 |
| Grand Junction..... | 84 | 26 | 49.5 | 1.13 | Wellington..... | 90 | 24 | 56.4 | 6.06 |
| Lewis, Fort..... | 76 | 8 | 40.6 | 0.72 | Wakefield..... | 91 | 23 | 54.0 | 2.01 |
| <i>Connecticut.</i> | | | | | W. Leavenworth..... | 87 | 26 | | 5.60 |
| Hartford..... | 75 | 21 | 49.5 | 2.39 | Wilson..... | 84 | 17 | 51.6 | 0.57 |
| North Colebrook..... | 74 | 17 | 44.2 | 1.12 | Yates Centre..... | 88 | 22 | 52.4 | 1.91 |
| Voluntown..... | 78 | 25 | | 2.95 | <i>Kentucky.</i> | | | | |
| <i>Dakota.</i> | | | | | Bowling Green..... | 82 | 37 | | 0.68 |
| A. Lincoln, Fort..... | 80 | 2 | 41.3 | 0.55 | <i>Louisiana.</i> | | | | |
| Garden City..... | 80 | 8 | 41.8 | 1.02 | Grand Coteau..... | 86 | 36 | 66.1 | 2.70 |
| Meade, Fort..... | 82 | 11 | 43.1 | 0.40 | <i>Maine.</i> | | | | |
| Parkston..... | | | | 0.15 | Bar Harbor..... | 66 | 26 | | 3.53 |
| Pemba, Fort..... | 73 | 9 | 36.2 | 0.13 | Cornish..... | 69 | 24 | 45.1 | 2.04 |
| Randall, Fort..... | 82 | 0 | 46.2 | 0.36 | Gardiner..... | 70 | 25 | 46.2 | 2.44 |
| Richardson..... | 78 | 1 | 41.2 | 1.07 | Orono..... | 66 | 21 | 44.7 | 3.00 |
| Sisseton, Fort..... | 75 | 6 | 38.7 | 0.94 | Skowhegan..... | 66 | 18 | 44.5 | 1.77 |
| Sully, Fort..... | 79 | 4 | 45.3 | 0.55 | <i>Maryland.</i> | | | | |
| Totten, Fort..... | 65 | 1 | 36.5 | 0.83 | Cumberland..... | 76 | 24 | 50.0 | 0.39 |
| Webster..... | 76 | 1 | 39.6 | 1.44 | Fallston..... | 82 | 29 | 52.9 | 1.37 |
| Yates, Fort..... | 81 | 1 | 43.4 | 0.74 | Great Falls..... | 85 | 30 | 54.9 | 1.49 |
| <i>District of Columbia.</i> | | | | | McDonogh..... | 79 | 29 | 55.1 | 1.13 |
| Distribut'g res'v'..... | 85 | 31 | 56.9 | 1.70 | McHenry, Fort..... | 83 | 31 | 64.2 | 0.58 |
| Kendall Green..... | 83 | 34 | 57.7 | 1.88 | New Midway..... | 85 | 26 | 51.5 | 1.03 |
| Receiving res'v'..... | 84 | 34 | 56.2 | 1.92 | Woodstock..... | 80 | 25 | 52.5 | 1.19 |
| Rock Creek Bridge..... | 87 | 33 | 59.3 | | <i>Massachusetts.</i> | | | | |
| <i>Florida.</i> | | | | | Amherst..... | 74 | 17 | 47.0 | 2.10 |
| Alva..... | 88 | 44 | 73.7 | 6.00 | Amherst..... | 73 | 17 | 48.1 | 2.21 |
| Archer..... | 95 | 37 | 71.6 | 1.19 | Blue Hill Obs'v'..... | 72 | 23 | 47.8 | 2.69 |
| Duke..... | 89 | 42 | 72.2 | 3.39 | Blue Hill Obs'v'..... | 74 | 20 | | 2.76 |
| Fort Meade..... | 90 | 42 | 66.0 | 4.00 | Deerfield..... | 74 | 18 | 47.9 | 2.58 |
| Homeland..... | 89 | 44 | 76.7 | 4.65 | Dudley..... | 70 | 21 | 49.1 | 2.39 |
| Limona..... | 88 | 45 | 76.2 | 5.66 | Fall River..... | 75 | 26 | 50.3 | 2.79 |
| Manatee..... | 93 | 47 | 77.2 | 3.65 | Milton..... | 72 | 23 | 46.4 | 2.73 |
| Merritt's Island..... | 86 | 46 | 75.8 | 8.19 | New Bedford..... | 73 | 20 | 50.3 | 3.83 |
| Fort St. Augustine..... | 86 | 52 | 73.7 | 5.80 | North Truro..... | | | | 1.51 |
| Tallahassee..... | 86 | 36 | 68.3 | 2.70 | Somerset..... | 82 | 24 | 52.6 | 2.64 |
| <i>Georgia.</i> | | | | | Taunton..... | 77 | 25 | 50.3 | 2.93 |
| Athens..... | 86 | 36 | 58.1 | 2.39 | Westborough..... | 76 | 18 | 50.8 | 2.80 |
| Forsyth..... | 91 | 44 | | 4.32 | Williamstown..... | 67 | 21 | 49.5 | 1.13 |
| Milledgeville..... | 81 | 40 | 62.0 | 5.33 | <i>Michigan.</i> | | | | |
| Quitman..... | 87 | 37 | 67.5 | 2.95 | Birmingham..... | 77 | 16 | | 2.83 |
| <i>Idaho.</i> | | | | | Brady, Fort..... | 62 | 31 | | 4.07 |
| Boise Barracks..... | 80 | 18 | 51.9 | T | Harrisville..... | 78 | 10 | 42.9 | 5.14 |
| Sherman, Fort..... | 70 | 13 | 46.2 | 1.63 | Hudson..... | 81 | 14 | 43.1 | 2.86 |
| Lewiston..... | 93 | 22 | | 0.66 | Kalamazoo..... | 75 | 23 | 49.0 | 2.41 |
| <i>Illinois.</i> | | | | | Lansing..... | 72 | 13 | 45.2 | 2.28 |
| Charleston..... | 86 | 20 | 49.3 | 0.97 | Marshall..... | 77 | 17 | | 3.15 |
| Jacksonville..... | 83 | 19 | 50.2 | 0.30 | Mottville..... | 76 | 17 | | 3.55 |
| Rockford..... | 81 | 16 | 44.2 | 2.09 | Thornville..... | 80 | 20 | 46.1 | 2.01 |
| Sandwich..... | 84 | 16 | 48.8 | 2.95 | Traverse City..... | 78 | 13 | 43.0 | 4.09 |
| South Evanston..... | 84 | 9 | | 2.00 | <i>Minnesota.</i> | | | | |
| <i>Indiana.</i> | | | | | Minneapolis..... | 67 | 12 | 40.9 | 2.45 |
| Butlerville..... | 82 | 26 | 52.3 | 0.96 | Snelling, Fort..... | 73 | 9 | 41.8 | 1.30 |
| Jeffersonville..... | 84 | 26 | 54.2 | 0.43 | <i>Mississippi.</i> | | | | |
| Laconia..... | 84 | 21 | 50.0 | 0.35 | Biloxi..... | 84 | 37 | 67.8 | 4.91 |
| Logansport..... | 86 | 22 | 50.5 | 1.90 | <i>Missouri.</i> | | | | |
| Mauzy..... | 78 | 14 | 43.0 | 0.61 | Conception..... | 83 | 22 | 50.0 | 2.25 |
| Sumner..... | 80 | 22 | 51.3 | 0.74 | Fayette..... | 92 | 18 | 53.6 | 1.57 |

Meteorological record of voluntary observers, etc.—Continued.

| Stations. | Temperature. (Fahrenheit.) | | | Precipitation. | Stations. | Temperature. (Fahrenheit.) | | | Precipitation. |
|------------------------|-------------------------------|----------|-------|----------------|------------------------------|-------------------------------|----------|-------|----------------|
| | Maximum. | Minimum. | Mean. | | | Maximum. | Minimum. | Mean. | |
| <i>Montana.</i> | | | | | <i>Oregon.</i> | | | | |
| Keogh, Fort..... | 86 | — | 44.2 | 1.14 | Albany..... | 78 | 28 | 52.8 | 0.97 |
| Missoula, Fort..... | 67 | — | 41.8 | 1.36 | Bandon..... | 72 | 30 | ..... | 1.43 |
| Shaw, Fort..... | 79 | — | 45.1 | ..... | East Portland..... | 72 | 30 | ..... | 0.06 |
| <i>Nebraska.</i> | | | | | <i>Eola.....</i> | | | | |
| Brownville..... | 86 | 22 | 54.5 | ..... | Klamath, Fort..... | 82 | 11 | 46.2 | 0.13 |
| De Soto..... | 84 | 11 | 48.8 | 1.33 | La Grande..... | 77 | 28 | 47.3 | 0.51 |
| Fairbury..... | 84 | 20 | ..... | 0.57 | Mount Angel..... | 82 | 26 | 52.0 | 2.00 |
| Fremont..... | 84 | 11 | 48.1 | 1.62 | Yaquina L. H..... | 82 | 38 | 51.7 | 2.26 |
| Genoa..... | 79 | 11 | 47.8 | 0.62 | <i>Pennsylvania.</i> | | | | |
| Hay Springs..... | 85 | 2 | 40.4 | 1.45 | Altoona..... | 79 | 22 | 52.5 | 0.90 |
| Marquette..... | 77 | ..... | ..... | 0.50 | Bethlehem..... | 82 | 23 | 52.0 | 1.12 |
| Niobrara, Fort..... | 93 | 4 | 48.2 | 0.96 | Blooming Grove..... | 82 | 17 | ..... | 2.25 |
| Robinson, Fort..... | 88 | 1 | 44.9 | 8.60 | Catawissa..... | 80 | 18 | ..... | 0.50 |
| Sidney, Fort..... | 90 | 0 | 44.9 | ..... | Corry..... | 83 | 15 | 45.7 | 5.45 |
| Tecumseh..... | 83 | 20 | 50.8 | 0.70 | Dyberry..... | 77 | 14 | 46.2 | 1.24 |
| <i>Nevada.</i> | | | | | <i>Easton.....</i> | | | | |
| Carson City..... | 88 | 19 | 49.2 | 0.04 | Fallsington..... | 79 | 29 | 50.9 | 1.41 |
| McDermitt, Fort..... | 82 | 18 | 50.7 | ..... | Drifton..... | 80 | 18 | 46.9 | 1.16 |
| <i>New Hampshire.</i> | | | | | <i>Franklin.....</i> | | | | |
| Ashland..... | ..... | ..... | ..... | 1.72 | Germantown..... | 80 | 28 | ..... | 0.26 |
| Belmont..... | ..... | ..... | ..... | 1.40 | Grampan Hills..... | 78 | 10 | 45.4 | 0.81 |
| Berlin Mills..... | ..... | ..... | ..... | 1.89 | Indiana..... | 71 | 20 | ..... | ..... |
| Bristol..... | ..... | ..... | ..... | 1.80 | Meadville..... | 74 | 36 | 52.4 | ..... |
| Lake Village..... | ..... | ..... | ..... | 1.53 | Phillipsburg..... | 78 | 10 | 43.3 | 0.35 |
| Nashua..... | 74 | 20 | 47.8 | 2.36 | Quakertown..... | 82 | 23 | 49.1 | 1.70 |
| Wier's Bridge..... | ..... | ..... | ..... | 1.27 | State College..... | 78 | 12 | 48.5 | 0.46 |
| Wolfeborough..... | ..... | ..... | ..... | 2.10 | Wellaborough..... | 80 | 15 | 45.3 | 2.54 |
| Woodstock..... | ..... | ..... | ..... | 2.80 | West Chester..... | 84 | 26 | 52.0 | 1.76 |
| <i>New Jersey.</i> | | | | | <i>Westtown.....</i> | | | | |
| Beverly..... | 81 | 28 | 53.1 | 2.42 | <i>South Carolina.</i> | | | | |
| Clayton..... | 89 | 28 | 52.8 | 2.22 | Cedar Springs..... | 91 | 26 | 62.0 | 3.48 |
| Dover..... | 82 | 24 | 48.5 | 1.99 | Kirkwood..... | 77 | 34 | 55.9 | 7.23 |
| Egg Harbor City..... | 87 | 23 | 53.0 | 3.78 | Stateburg..... | 84 | 38 | 60.6 | 8.15 |
| Moorestown..... | 84 | 29 | 52.0 | 1.93 | <i>Tennessee.</i> | | | | |
| Roseland..... | ..... | ..... | ..... | 3.10 | Ashwood..... | 83 | 28 | 55.5 | 2.81 |
| South Orange..... | 78 | 30 | 53.0 | 1.90 | Austin..... | 86 | 26 | 54.0 | 2.07 |
| Vineland..... | 80 | 30 | 55.3 | 2.44 | Milan..... | 87 | 26 | 56.0 | 1.22 |
| <i>New Mexico.</i> | | | | | <i>Texas.</i> | | | | |
| Bayard, Fort..... | 95 | 38 | 62.0 | 0.82 | Austin..... | 90 | 41 | 68.2 | 3.64 |
| Gallinas Spring..... | 80 | 29 | ..... | 1.45 | Cedar Hill..... | ..... | ..... | ..... | 6.50 |
| Las Vegas..... | 83 | 27 | ..... | 0.25 | Cleburne..... | 88 | 35 | 61.0 | 2.42 |
| Selden, Fort..... | 98 | 30 | 61.8 | 0.74 | Concho, Fort..... | 92 | 34 | 62.6 | 1.74 |
| Union, Fort..... | 81 | 27 | 51.8 | 1.70 | Corcoran..... | ..... | ..... | ..... | 1.47 |
| Wingate, Fort..... | 78 | 26 | 48.7 | 1.10 | Midland, Fort..... | 90 | 42 | 69.4 | 0.15 |
| <i>New York.</i> | | | | | <i>Midland.....</i> | | | | |
| Auburn..... | 74 | 24 | 48.8 | 1.75 | New Ulm..... | 93 | 44 | 67.0 | 2.70 |
| Ardania..... | 79 | 28 | ..... | 4.12 | Ringgold, Fort..... | 93 | 39 | 70.1 | 1.95 |
| Brooklyn..... | 76 | 29 | 55.0 | 0.53 | Silver Falls..... | 96 | 31 | ..... | 2.10 |
| Boyd's Corners..... | 76 | 27 | ..... | 3.12 | <i>Vermont.</i> | | | | |
| Columbus, Fort..... | 76 | 31 | 53.5 | 2.51 | Brattleborough..... | 74 | 45 | ..... | 2.46 |
| Cooperstown..... | 72 | 20 | 44.7 | 1.19 | Burlington..... | 71 | 24 | 47.7 | 1.99 |
| Factoryville..... | 78 | 17 | 46.1 | 2.11 | Lunenburg..... | 78 | 15 | 43.6 | 2.39 |
| Humphrey..... | 75 | 21 | 45.2 | 3.96 | Manchester..... | 68 | 22 | 46.0 | 3.47 |
| Ithaca..... | 78 | 17 | 46.3 | 1.45 | Newport..... | 66 | 26 | 45.4 | 1.83 |
| Le Roy..... | 76 | 21 | 45.4 | 1.71 | Stratford..... | 70 | 22 | 45.9 | 2.00 |
| Madison Barracks..... | 68 | 12 | ..... | 5.38 | <i>Virginia.</i> | | | | |
| Menands..... | 68 | 29 | 48.4 | 2.69 | Bird's Nest..... | 87 | 41 | 61.3 | 6.35 |
| Niagara, Fort..... | 77 | 24 | 48.5 | 1.12 | Christianburg..... | ..... | ..... | ..... | 2.00 |
| Palermo..... | 69 | 23 | 41.9 | 1.93 | Dale Enterprise..... | 89 | 28 | 56.9 | 1.55 |
| Plattsburgh..... | 77 | 22 | 48.1 | ..... | Marion..... | 76 | 25 | 49.0 | 2.88 |
| Penn Yan..... | 69 | ..... | ..... | 1.46 | Monroe, Fort..... | 88 | 40 | 60.8 | 8.11 |
| Plattsburgh B'ks..... | 69 | 22 | 46.0 | 1.24 | Sappahannock..... | 90 | 21 | 59.8 | 6.22 |
| Port Jervis..... | 67 | 23 | ..... | 2.26 | Summit..... | 84 | 24 | 53.2 | ..... |
| Putnam..... | 74 | 33 | 53.2 | 3.76 | University of Va..... | 78 | 36 | 56.8 | 2.51 |
| Roseton..... | 80 | 6 | ..... | ..... | Variety Mills..... | 85 | 25 | 52.0 | 3.30 |
| Utica..... | 83 | 28 | 42.8 | ..... | Wytheville..... | 79 | 26 | 51.2 | 3.46 |
| West Point..... | 80 | 28 | ..... | 3.30 | <i>Washington Territory.</i> | | | | |
| White Plains..... | 78 | 28 | 53.7 | 1.70 | Blakely..... | 65 | 29 | 50.0 | 1.45 |
| <i>North Carolina.</i> | | | | | <i>Kennewick.....</i> | | | | |
| Chapel Hill..... | 92 | 34 | 57.0 | 11.21 | Tacoma..... | 78 | 15 | ..... | 0.20 |
| Fort Springs..... | 79 | 31 | 55.0 | ..... | Townsend, Fort..... | 66 | 37 | 50.3 | 1.44 |
| Lenoir..... | 77 | 33 | ..... | 4.10 | Spokane, Fort..... | 60 | 31 | 50.2 | 1.47 |
| Lincolnton..... | 74 | 35 | 53.6 | 3.91 | Vashon..... | 73 | 13 | 46.0 | 4.40 |
| Marion..... | 82 | 28 | ..... | 4.23 | Walla Walla, Fort..... | 75 | 20 | 51.0 | 0.61 |
| Salisbury..... | 88 | 36 | 59.0 | 9.80 | <i>West Virginia.</i> | | | | |
| Stateville..... | 80 | 35 | 55.0 | 6.51 | Clarksburg..... | 79 | 18 | 50.3 | 0.87 |
| Veldon..... | 87 | 34 | 56.3 | 9.97 | Helvetia..... | 76 | 22 | 48.9 | 1.20 |
| <i>Ohio.</i> | | | | | <i>Parkersburg.....</i> | | | | |
| Cleveland..... | 81 | 24 | 49.6 | 2.25 | <i>Wisconsin.</i> | | | | |
| College Hill..... | 84 | 25 | 52.4 | 0.13 | Beloit..... | 78 | 14 | 44.5 | 2.00 |
| Clyde..... | 84 | 21 | 61.2 | 1.23 | Delavan..... | 80 | 2 | 42.6 | 2.47 |
| Conneautville..... | 81 | 24 | 45.0 | 1.31 | Embarras..... | 75 | 6 | 43.8 | 4.50 |
| Coram..... | 77 | 21 | 46.9 | 1.86 | Fond du Lac..... | 73 | 11 | 43.1 | 2.20 |
| Dickinson..... | 80 | 26 | 52.5 | 0.40 | Franklin..... | 75 | 14 | 44.0 | 2.09 |
| Edinburg..... | 77 | 22 | 48.4 | 2.22 | Manchester..... | 83 | 2 | 44.6 | 2.58 |
| Fort Lewisburg..... | 83 | 20 | 50.6 | 0.45 | Madison..... | 77 | 12 | 44.1 | 3.18 |
| Fortmouth..... | 82 | 30 | 51.6 | 0.72 | Manitowoc..... | 69 | 11 | 44.8 | 3.37 |
| Gallsville..... | 83 | 25 | 47.8 | 0.94 | Prairie du Chien..... | 84 | 11 | 44.8 | 3.06 |
| Jefferson..... | 83 | 15 | 46.5 | 1.97 | <i>Wyoming.</i> | | | | |
| Jeffersonville..... | 80 | 17 | 47.6 | 0.49 | Camp Sheridan..... | 78 | — | 39.1 | 1.10 |
| Lebanon..... | 82 | 26 | 53.1 | 1.75 | Laramie, Fort..... | 87 | 8 | 44.8 | 0.16 |
| Lebanon Springs..... | 79 | 19 | 50.8 | 0.45 | McKinney, Fort..... | 84 | — | 42.4 | 0.44 |
| | | | | | Washakie, Fort..... | 84 | — | 41.9 | 0.93 |

Chart I. Tracks of Areas of Low Pressure

Form 106 C 1884.



s of Low Pressure. October, 1887.

PARTMENT WEATHER MAP.

HED BY ORDER OF THE
RETARY OF WAR.

ELY, Chief Signal Officer.

as for the Signal Service are
at 7 A.M. 3 P.M. & 10 P.M.
75° Meridian Time

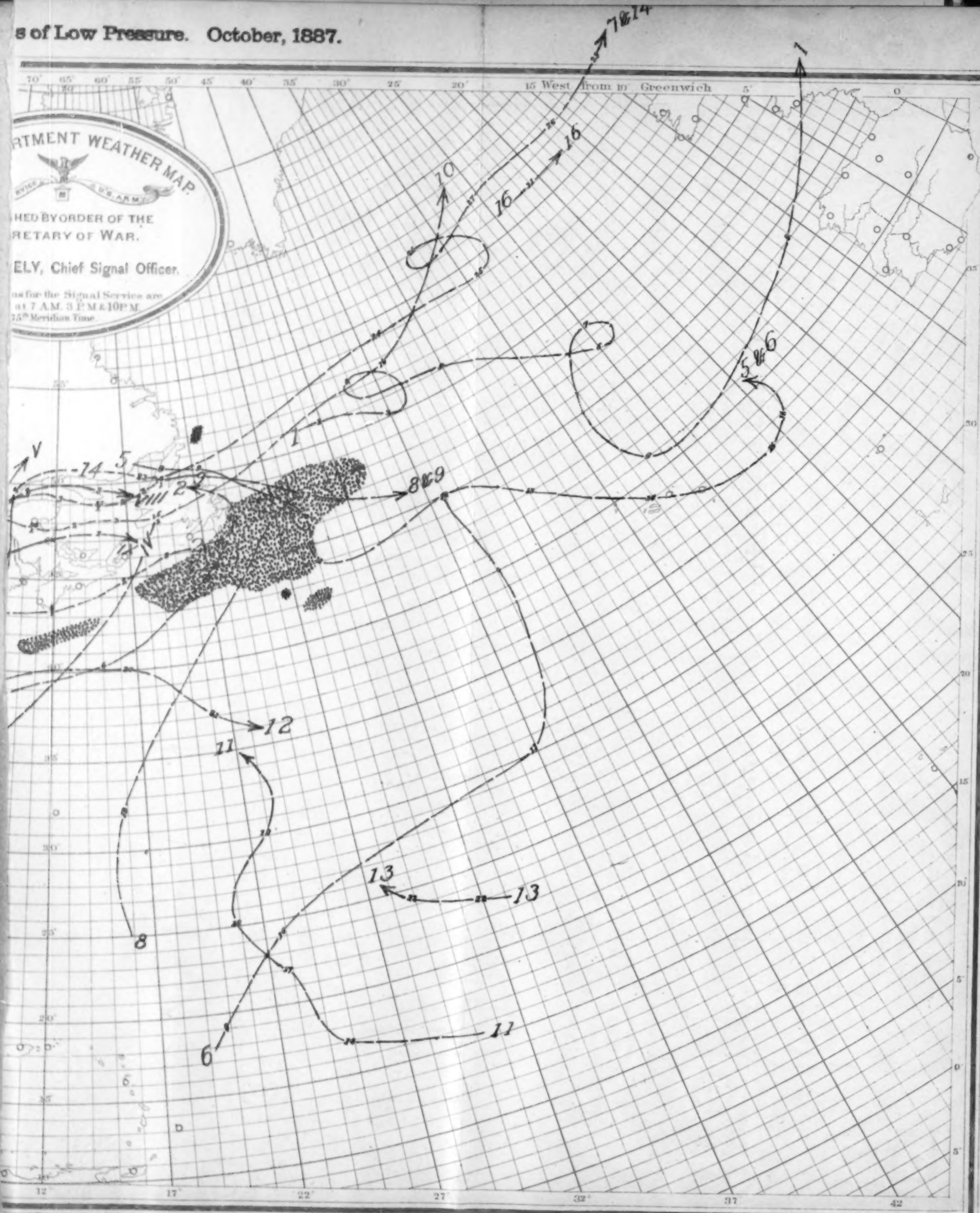




Chart II. Isobars, Isotherms, and Winds. October, 1887.

Form 106 F.

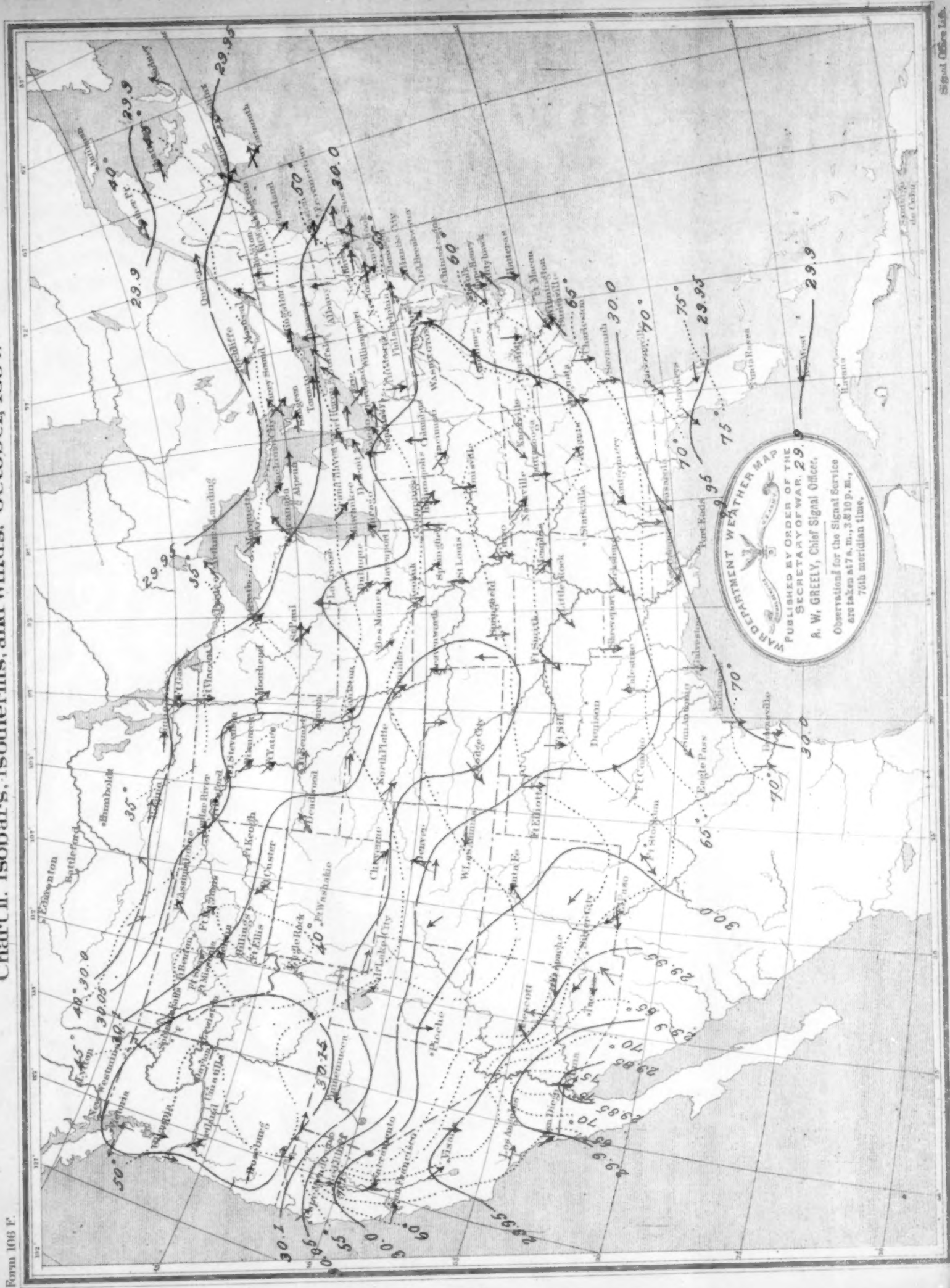


Chart III. Departures from Normal Atmospheric Pressure and Temperature. October, 1887.

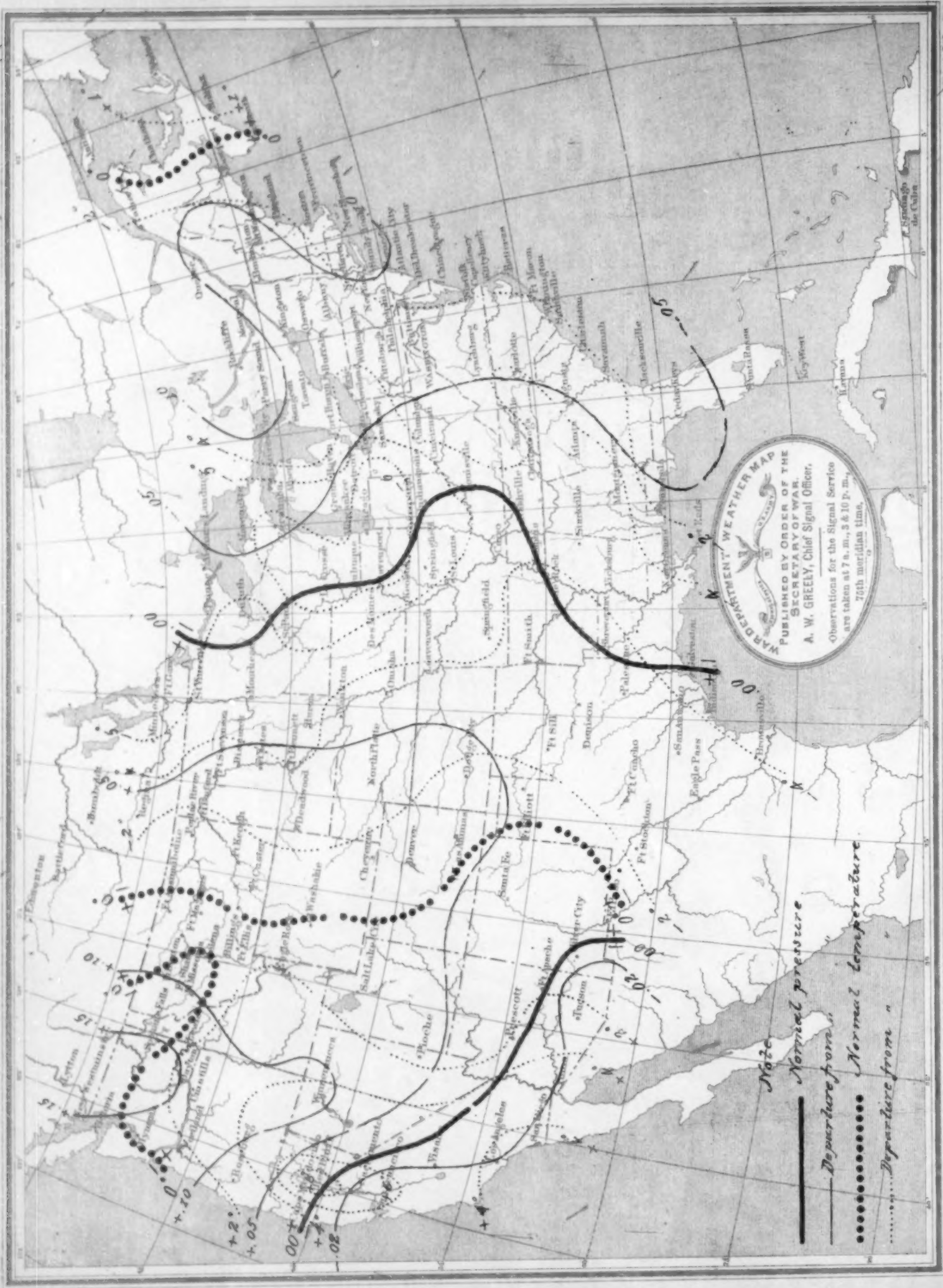
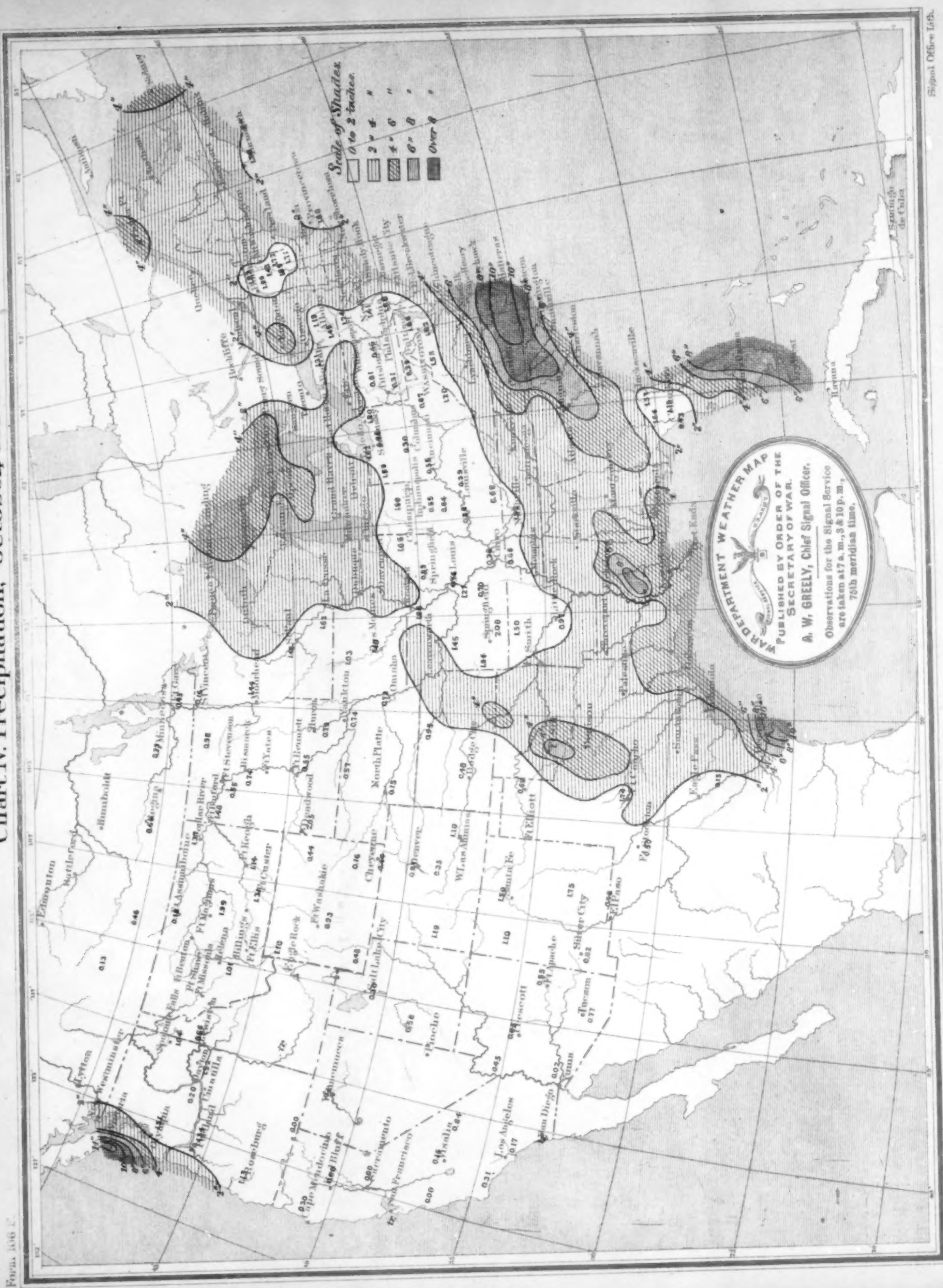


Chart IV. Precipitation, October, 1887.

Chart IV. Precipitation, October, 1887.

Form 106 E.



| Observer and place of observation. | Observer and place of observation. | Observer and place of observation. | Observer and place of observation. |
|---|---|---|---|
| Alexander, S., Birmingham, Mich. | Dinsmore, Prof. F. H., Emporia, Kans. | Jordan, Dr. M. D. L., Milan, Tenn. | Silvius, U. O., Franklin, Wis. |
| Acosta, L. P., "Director," Mazatlan, Mex. | Donald, H. D., Decatur, Tex. | Kirkwood, E., Maury, Ind. | Snell, Miss S. C., Amherst, Mass. |
| Anderson, Dr. W. W., Stateburg, S. C. | Drake, W. T., Marshall, Mich. | Knap, J. G., Limona, Fla. | Sonedecker, Rev. T. H., Tiffin, Ohio. |
| Altamir, J. M., Independence, Kans. | Dudley, Chas. B., Altoona, Pa. | Keese, G. Pomeroy, Cooperstown, N. Y. | Smith, John R., North Truro, Mass. |
| Abbott, Dr. E. K., Salinas, Cal. | Dunlap, W. L., Tecumseh, Nebr. | Koontz, Alph., Albion, Iowa. | Snow, Prof. F. H., Lawrence, Kans. |
| Arents, Hiram, Oroville, Cal. | Dazey, J. B., Charleston, Ill. | Lincoln, A. T., Marion, Va. | Sim, J. R., Summit, Va. |
| Adams, A. H., Fort Meade, Fla. | Deming, H. D., Wellsborough, Pa. | Loveland, Wm. Corry, Pa. | Scribner, H. F. J., Strafford, Vt. |
| Adams, Dr. O. H., Vineland, N. J. | Davis, McLean W., Indiana, Pa. | Loomis, J. C., Jeffersonville, Ind. | Strong, S. B., Setauket, N. Y. |
| Andrews, Luman, Southington, Conn. | Dewhurst, Rev. E., Voluntown, Conn. | Logan, David, Meadville, Pa. | Swartz, John J., Parkston, Dak. |
| Arden, Richard B., Garrison's, N. Y. | Day, Theodore, Dyberry, Pa. | Luther, S. M., Garretttsville, Ohio. | Samostz, Oscar, Austin, Tex. |
| Boynton, J. F., Syracuse, N. Y. | Ellsworth, W. W., Hartford, Conn. | Lurch & Rice, Bethlehem, Pa. | Smith, George F., New Midway, Md. |
| Beana, Thos. J., Moorestown, N. J. | Edgington, R. P., Morse, Kans. | Lups, Miss Clatina, Manitowoc, Wis. | Standenmayer, Dr. L. R., Lincoln, N. C. |
| Beall, Joseph, Franklin, Pa. | Ellison, W. A., Statesville, N. C. | Lounds, R. T., Clarksburg, W. Va. | Trembley, Dr. J. B., Oakland, Cal. |
| Boerner, Prof. Chas. G., Vevay, Ind. | Ellis, John, Marquette, Nebr. | Manning, Thomas, Carmel, N. Y. | Tilford, C. M., Silver Falls, Tex. |
| Bently, David, Willows, Cal. | Ewell, Dr. M. D., South Evanston, Ill. | Morgan, L. Ray, Phillipsburg, Pa. | Tillinghast, C. B., Albany, N. Y. |
| Bayerly, J. F., Spartanburg, S. C. | Evans, J. W., Alma, Colo. | McDonogh Institute, McDonogh, Md. | Teale, Rev. A. K., Blue Hill, Mass. |
| Ballou, Dr. N. E., Sandwich, Ill. | Eckstein, Rev. M., Conception, Mo. | McClintock, Frank, Grand Junction, Colo. | Truman, Geo. S., Genoa, Nebr. |
| Bennett, Geo., Bandon, Oregon. | Foss, E. T., Hydville, Cal. | Marshall, Gregory, Cresco, Iowa. | Turnbo, Silas C., Pro Tem, Mo. |
| Boies, Lt. A. H., Hudson, Mich. | Ferris, B. F., Sunman, Ind. | Massachusetts Agricultural Experimental Station, Amherst, Mass. | Tuohy, John, Lewis Creek, Cal. |
| Baker, Dr. Henry B., Lansing, Mich. | Fouch, Dr. A., Andersonville, Cal. | McCreedy, Miss L. A., Ft. Madison, Iowa. | Thomas, Felix, Saratoga Springs, N. Y. |
| Beall, Dr. R. L., Lenoir, N. C. | Friend, Chas. W., Carson City, Nev. | McGahan, Dr. C. F., Hot Springs, N. C. | Thrasher, B., Newport, Vt. |
| Bartlett, E. B., Vermillion, N. Y. | Ferrill, B. P., Duke, Fla. | Mikesell, Thos., Wauseon, Ohio. | Vail, Hugh D., Santa Barbara, Cal. |
| Briggs, John, Albany, Oregon. | Frear, Wm., State College, Pa. | Mickle, J. H., Variety Mills, Va. | Vermillion, W. W., Frankford, Mo. |
| Betts, Prof. Arthur, Webster, Dak. | Fernald, Prof. M. C., Orono, Me. | Macrae, Collin, Kirkwood, S. C. | Voegell, Adolphus, Des Moines, Iowa. |
| Breed, J. E., Embarras, Wis. | Fuller, Edw. N., Tacoma, Wash. | Mechan, Thomas, Germantown, Pa. | Wedge, J. C., Fond du Lac, Wis. |
| Beloit College, Observatory, Beloit, Wis. | Featherston, Wm., Globe, Kans. | Moore, Dr. J. W., Easton, Pa. | Wade, J. S., Homeland, Fla. |
| Birt, Thomas, Utica, N. Y. | Field, T. G., Parkersburg, W. Va. | Motte, Luke S., West Milton, Ohio. | Washburn Observatory, Madison, Wis. |
| Broberg, Mrs. Mary W., Manatee, Fla. | Ford, H. C., El Dorado, Kans. | Moore, Nathan, Grampian Hills, Pa. | Wild, Rev. E. P., Manchester, Vt. |
| Black, W. H., Kalamazoo, Mich. | Gibson, J. H., Salina, Kans. | Mitchell, Dr. D. W., Harrisville, Mich. | Williams, Rev. C. F., Ashwood, Tenn. |
| Blachly, C. P., Manhattan, Kans. | Gates, W. B., Burlington, Vt. | Newcomb, G. S., Westborough, Mass. | West, Silas, Cornish, Me. |
| Bridges, Q. A., Berlin Mills, N. H. | Gray, F. R., Yates-Centre, Kans. | Nordberg, Prof. A., Richardson, Dak. | Wells, Rev. Charles L., Gardiner, Me. |
| Bowman, Peter, Ruggles, Ohio. | Gillingham, Milnor, Fallsington, Pa. | Newell, Dr. W. C. T., Garden City, Dak. | Wylie, Wm., Mount Forest, Canada. |
| Bush, John W., Worcester, N. Y. | Goodspeed, Chas. W., Elyria, Ohio. | Neal, Dr. J. C., Archer, Fla. | Walt, S. E., Traverse City, Mich. |
| Cole, Seward, Cahuenga, Cal. | Gowey, H. D., North Lewisburg, Ohio. | Osborn, Dr. T. C., Cleburne, Tex. | Washington { Receiving Reservoir, D. C. |
| Chatfield, F. W., Las Vegas, N. Mex. | Green, Dr. Jesse C., West Chester, Pa. | Olds, H. D., Cedar Rapids, Iowa. | Aqueduct { Distributing " " |
| Cook, S. A., Milledgeville, Ga. | Gerrish, S. H., Sacramento, Cal. | Owsley, Dr. J. B., Jacksonborough, O. | Great Falls Reservoir, Md. |
| Carrington, G. D., Brownville, Nebr. | Goodwin, Rev. William, North Colebrook, Conn. | Pearce, Thomas, Eola, Oregon. | Rock Creek Bridge, D. C. |
| Calhoun, P. B., Austin, Tenn. | Gibbs, Geo. I., Grand Turk, Turk's Island, British W. Indies. | Prouty, Florence, Humboldt, Iowa. | Woodstock College, Woodstock, Md. |
| Carpenter, Dr. W. B., Leavenworth, K. | Gray, Capt. A. W., Kenewick, Wash. | Peele, Capt. Adolphus, New Westminster, B. C. | Williams College Observatory, Williamstown, Mass. |
| Charbonnier, Prof. L. H., Athens, Ga. | Grathwohl, John, Blooming Grove, Pa. | Palmer, Frank W., Antrim, N. H. | Wolfe, John H., Wellington, Kans. |
| Chapin, Adams, Poway, Cal. | Gore, Prof. J. W., Chapel Hill, N. C. | Peckham, Prof. W. C., Brooklyn, N. Y. | Wulfke, E. F., Independence, Iowa. |
| Casey, Geo., Auburn, N. Y. | Holt, A. K., Riverside, Cal. | Pollock, Edw., Lancaster, Wis. | Wearmouth, James, University of Virginia, Va. |
| Cornell University, Ithaca, N. Y. | Humphrey, Dr. J., Fairbury, Nebr. | Postma, H. Y., Egg Harbor City, N. J. | Winipiseogee { Weir's Bridge, N. H. |
| Collins, Prof. Alonzo, Mount Vernon, Iowa. | Hamilton, W. H., Corsicana, Tex. | Pendleton, A., Nicolaus, Cal. | Woodstock, N. H. |
| Cutting, Dr. Hiram A., Lunenburg, Vt. | Harvard College Observatory, Cambridge, Mass. | Romig, J. K., La Grande, Oregon. | Lake Cotton { Wolfborough, N. H. |
| Clark, F. A., Weldon, N. C. | Hammitt, John W., College Hill, Ohio. | Renfrew, H. N., Bancroft, Iowa. | Lake Village, N. H. |
| Childs, W. H., Brattleborough, Vt. | Harris, T. C., Raleigh, N. C. | Rathburn, J. C., Midland, Tex. | Bristol, N. H. |
| Cutler, B. B., Heath, Mass. | Heaton, Isaac E., Fremont, Nebr. | Remington, C. V. S., Fall River, Mass. | Belmont, N. H. |
| Collie, G. L., Delavan, Wis. | Hoskinson, R. M., Blakely, Wash. | Robertson, T. D., Rockford, Ill. | Ashland, N. H. |
| Conant Observatory, Dudley, Mass. | Hardy, Samuel E., East Norway, Kans. | Roberts, Luke, Clinton, Iowa. | Willis, O. R., A. M., Ph. D., White Plains, N. Y. |
| Cotton, Dr. D. B., Portsmouth, Ohio. | Hyde, G. A., Cleveland, Ohio. | Runge, C., New Ulm, Tex. | Wood, Joseph, Bar Harbor, Me. |
| Cheney, Wm., Minneapolis, Minn. | Hartzler, J. A., Mottville, Mich. | Richardson, C. F., Beverly, N. J. | Wigg, Dr. Geo., East Portland, Oregon. |
| College of Sacred Heart, Prairie du Chien, Wis. | Hole, C. F., Butlerville, Ind. | Rotch, A. L., Blue Hill Observatory, Blue Hill, Mass. | Wright, J. W. A., Livingston, Ala. |
| Carter, Rev. Dr. W. H., Tallahassee, Fla. | Held, Rev. F. B., Mount Angel, Oreg. | Rodman, Thomas R., New Bedford, Mass. | Whitney, Chas. E., Humphrey, N. Y. |
| Cummings, L. D., Palmyra, N. Y. | Heatwole, L. J., Dale Enterprise, Va. | Rice, Chas. W., Yellow Springs, Ohio. | Whitney, William A., Skowhegan, Me. |
| Crump, M. H., Bowling Green, Ky. | Harris, W. C., Dover, N. J. | Stern, Jacob T., Logan, Iowa. | Widman, Rev. C. M., Grand Coteau, La. |
| Crozier, Lase, Laconia, Ind. | Hunter, Dr. T. C., Napoleon, Ohio. | Smith, H. D., Monticello, Iowa. | Williams, Dr. A. C., Elk Falls, Kans. |
| Cochran, Wm. P., Wakefield, Kans. | Helm, Thos. B., Logansport, Ind. | Shaw, E., Ninescaw, Kans. | White, Rev. J. H., Georgiana, Fla. |
| Caulkins, John S., Thornville, Mich. | Heacock, J. L., Quakertown, Pa. | Seltz, Chas., De Soto, Nebr. | Wetmore, Edw. L., Tucson, Ariz. |
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| Curtiss, G. G., Fallston, Md. | Hasenstab, Philip J., Jacksonville, Ill. | Schleicher, Rob't Lewiston, Idaho. | Waterman, Wm., Hay Springs, Nebr. |
| Colton, Prof. G. H., Hiram, Ohio. | Haywood, Prof. John, Westerville, Ohio. | Shriver, Howard, Wytheville, Va. | Webster, Chas. H., Nashua, N. H. |
| Comstock, Prof. F. M., LeRoy, N. Y. | Ireland, W. H., Rappahannock, Va. | Scott, Thos. G., Forsyth, Ga. | Yates, T. P., Factoryville, N. Y. |
| Craig, W. F., Marion, N. C. | Jessup, J. G., Newport, Oregon. | Stucky, Dr. C. T., Helvetia, W. Va. | Yetter, Wm. G., Catawissa, Pa. |
| Cutler, J. L., Quitman, Ga. | Jones, Dr. E. U., Taunton, Mass. | Slade, Elisha, Somerset, Mass. | Young, Geo. R., Penn Yan, N. Y. |
| Carpenter, Ford A., Vashon, Wash. | | Starr, Prof. Fred'k, Cedar Rapids, Iowa. | |
| Dollenmayer, E. Y., Wilson, Kans. | | | |

Military posts from which meteorological reports were received, through the Surgeon General of the Army, in time to be used in the preparation of the Monthly Weather Review for October, 1887.

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| Bayard, Fort, N. Mex. | Huachuca, Fort, Ariz. | McDowell, Fort, Ariz. | Presidio of San F., Cal. | Sisseton, Fort, Dak. | Union, Fort, N. Mex. |
| Benicia Barracks, Cal. | Klamath, Fort, Oreg. | Monroe, Fort, Va. | Plattsburg Barracks, N. Y. | Shaw, Fort, Mont. | Washakie, Fort, Wyo. |
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| Brady, Fort, Mich. | Lewis, Fort, Colo. | Madison Barracks, N. Y. | Reno, Fort, Ind. T. | Selden, Fort, Nebr. | Walla Walla, Ft., Wash. |
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| Columbus, Fort, N. Y. | H. McIntosh, Fort, Tex. | McKinney, Fort, Wyo. | Riley, Fort, Kans. | Spokane Fort, Wash. | |
| Camp Sheridan, Wyo. | | | | | |

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| Alabama, P. H. Mell, Jr., Signal Corps, director, Auburn, Ala. | New England Meteorological Society, Prof. Wm. H. Niles, of Boston, Mass., President; Prof. W. M. Davis, of Cambridge, Mass., Secretary. |
| Illinois, Col. Charles F. Mills, director, Springfield, Ill. | New Jersey, Prof. George H. Cook, director, New Brunswick, N. J. |
| Indiana, Prof. H. A. Huston, director, Lafayette, Ind. | North Carolina, Dr. Herbert Battle, director, Raleigh, N. C. |
| Kansas, Prof. J. T. Lovewell, director, Topeka, Kans. | Ohio, Prof. Benj. F. Thomas, director, Ohio State University, Columbus, Ohio. |
| Michigan, N. B. Conger, Sgt., Signal Corps, director, Lansing, Mich. | Oregon, Dr. S. Pague, Private, Signal Corps, Roseburg, Oregon. |
| Minnesota, Prof. W. W. Payne, director, Northfield, Minn. | Pennsylvania, under direction of Franklin Institute, Philadelphia, Pa. |
| Mississippi, Prof. R. B. Fulton, director, University, Miss. | South Carolina, Hon. A. P. Butler, director, Columbia, S. C. |
| Missouri, Prof. F. B. Nipher, director, Saint Louis. | Tennessee, J. D. Plunket, M. D., director; H. C. Bate, assistant, Nashville, Tenn. |
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